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Safety

VEHICLE MAINTENANCE SHOPS

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The criteria in this standard are the Air Force's minimum safety, occupational health, and fire prevention requirements. Major commands (MAJCOM), direct reporting units (DRU), and field operating agencies (FOA) may supplement this standard when additional or more stringent safety and health criteria are required. Refer to Air Force Instruction (AFI) 91-301, *Air Force Occupational and Environmental Safety, Fire Protection, and Health (AFOSH) Program*, for instructions on processing supplements or variances. Report conflicts in guidance between this standard, federal standards, or other Air Force directives through MAJCOM, DRU, or FOA ground safety offices to Headquarters Air Force Safety Center, Ground Safety Division, Safety Engineering and Standards Branch (HQ AFSC/SEGS), 9700 G Avenue, SE, Kirtland AFB, NM 87117-5670.

This standard includes general safety information applicable to vehicle maintenance operations. It addresses safety, occupational health, and fire prevention requirements associated with shop operations, material handling equipment, and repair of general purpose, special purpose, and installation maintenance vehicles. Not included are safety, occupational health, and fire prevention requirements addressed in specific equipment technical orders (TO). This standard implements regulatory provisions of several Occupational Safety and Health Administration (OSHA) standards and also includes Air Force criteria not addressed in the OSHA standards. OSHA requirements are identified in the text.

No Technical Order (TO), AFOSH Standard, or Operating Instruction can possibly address every hazard or potential hazard that may arise from a specific task or combination of tasks. Where situations exist that do not appear to be adequately covered by existing directives, use an Operational Risk Management (ORM) process to assess risk associated with those situations and determine adequate safeguards or procedures to manage the risk. **NOTE:** The ORM process may not be used to violate directives or other regulatory guidance. Normal waiver or variance procedures must be followed in all cases (refer to the first paragraph on page 1).

SUMMARY OF REVISIONS

Administrative changes have been made to update this standard to electronic format. Paragraphs have been renumbered and references updated, as appropriate. A glossary of references, abbreviations, acro-

nyms, and terms is provided at **Attachment 1**. Ordering instructions for rim charts and manuals are updated (**Attachment 2**). Minor changes will be annotated by a star (*). **NOTE:** AFOSH 127-series standards are being converted to 91-series standards and the 161-series to 48-series standards. However, not all standards have been converted as of the effective date of this standard. To help you locate these documents, references to AFOSH standards are stated in the updated series and standard number, with the outgoing series and standard number stated as “formerly designated as” in the references section of **Attachment 1**.

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Chapter 1

GENERAL

1.1. Hazards and Human Factors:

1.1.1. Eye, face, and body injuries in the vehicle maintenance shops may be caused by exposure to splashes from petroleum distillates into the eyes, by materials thrown from machines, or when air pressure propels substances at sufficient velocity to be injurious or fatal. Other injuries may occur when workers are exposed to petroleum vapors. Petroleum vapors can displace oxygen from enclosed spaces and pits having poor ventilation, making the environment in these areas incapable of supporting life. Entry into these areas under these conditions without suitable respiratory protection such as supplied air or self-contained breathing apparatus could result in asphyxiation. Escaping refrigerant, electrolyte, and cleaning materials can cause serious damage if they contact the eyes. Injury can result from contact with cleaning solvents and acids.

1.1.2. Brake and clutch assemblies installed on military vehicles may contain asbestos, which poses a hazard to vehicle maintenance personnel.

1.1.3. In recent years there has been an increase in hernias, back strains, crushed hands and feet, broken bones, and severe lacerations to vehicle maintenance personnel, resulting from poor manual handling practices. The injury problem has become more acute because of the greater size of equipment and materials being used (larger fire trucks, tires, engine components, etc.). Failure of maintenance personnel to use proper lifting techniques or mechanical lifting devices for handling heavy loads is the major cause of these injuries (refer to paragraph 1.2.13. for proper lifting techniques).

1.1.4. Fire or explosion is also a hazard in vehicle maintenance operations due to liquid fuel spills, fuels in vehicle tanks, or fuel vapors. Some of the hazards associated with the use of flammable and (or) combustible liquids include explosions, burns from fire, chemical burns, asphyxiation, inhalation of vapors, absorption through the skin, skin irritation, and eye damage from direct contact or exposure. The act of removing or changing outer clothing can create sufficient static electricity to cause ignition of a flammable or explosive fuel-air mixture. Touching a screwdriver or other metal tool to the wrong electrical terminal can cause a short circuit or sparks that, teamed with the presence of flammable or combustible liquids, vapors, or gases, could cause an explosion.

1.1.5. Tool misuse or abuse and the failure to properly use protective equipment has resulted in eye injuries, lacerations, punctures, burns, pinching, and bruises.

1.1.6. Many vehicle or maintenance mishaps result from:

1.1.6.1. Poor housekeeping practices.

1.1.6.2. Inadequate lighting and ventilation.

1.1.6.3. Inadequately trained personnel.

1.1.6.4. Poor shop layout.

1.1.6.5. Improper storage of flammable or combustible liquids.

1.1.6.6. Catching fingers, hair, necktie, or jewelry in moving pulleys and belts in the fan area.

1.1.6.7. Removing radiator cap on an overheated engine.

- 1.1.6.8. Working under vehicles without safety glasses or goggles, thus allowing rust or other debris to fall into the eyes.
 - 1.1.6.9. Elevating a vehicle using ramps that are not resting on a firm level surface.
 - 1.1.6.10. Crawling under a vehicle supported only by a jack and not using jack stands for additional support.
 - 1.1.6.11. Placing hands or feet directly under the wheel while changing a flat tire.
 - 1.1.6.12. Peering directly into the throat of a carburetor when the engine is running, resulting in face and hair burns or eye damage (or both) if the engine backfires through the carburetor.
 - 1.1.6.13. Leaving creepers on the floor.
 - 1.1.6.14. Wearing rings, watches, and other metallic jewelry when working on electrical systems.
 - 1.1.6.15. Failing to remove air pressure from tires on split rim wheels before dismantling the wheel for repairs.
- 1.1.7. During a charge or recharge of a lead-acid battery, gases are released in increasing quantities as the battery approaches full charge and will explode if ignited or exposed to an open flame or spark.
- 1.1.8. Hazardous noise exposure can harm employees in many ways. The effects of noise include loss of hearing, interference with speech communication, loss of sleep, and possible stress reactions which could have long term health results.
- 1.1.9. Painting operations present hazards requiring rigid controls. Mists and vapors produced by painting operations may be highly flammable. Violent explosions can result from accidental ignition of these vapors. Paints used in Air Force operations often contain toxic substances, such as lead, methylethylketone, toluene, xylene, and (or) isocyanates, which are potentially hazardous when inhaled. Skin irritations can also be caused by the toxic contents of paints.
- 1.1.10. The principal hazard present during the servicing of single piece rim wheels is that the pressurized air contained in the tire may suddenly be released either by the bead break-in, or by the bead slipping over the rim flange. These incidents are caused by mismatching of the wheel and tire, overinflation, using damaged components, failing to restrain the components, welding on the wheel, or improperly mounting the tire on the wheel. The resulting air blast is strong enough to hurl an employee who is in close proximity to the rim wheel, and positioned within the trajectory, violently across the workplace. When pressurized air is released on the side of the rim wheel against a solid surface, the flexure of the tire can also propel the rim wheel itself across the workplace and into anyone in its path (refer to paragraph 8.5.6.).
- 1.1.11. Contact lenses may trap toxic or dangerous substances that are harmful to the eye; they also decrease the effectiveness of emergency eyewash fountains. Soft contact lenses may absorb and be contaminated by chemicals and their vapors and fumes. Contact lenses provide little protection from external forces; they may even compound the severity of an injury.

1.2. General Requirements:

- 1.2.1. Exits and Exit Markings. Essential regulatory OSHA information is included below. (Refer to OSHA 29 Code of Federal Regulations [CFR] 1910.37, *Means of Egress, General*; AFI 32-2001, *The Fire Protection Operations and Fire Prevention Program*; National Fire Protection Association

(NFPA) 80, *Standard for Fire Doors and Windows*; and NFPA 101, *Code for Safety to Life from Fire in Buildings and Structures*, for additional information.)

1.2.1.1. Every exit will have the word "EXIT" in plain legible letters not less than 6-inches high with the strokes of the letters not less than three-fourths of an inch wide. The color of sign will contrast with decorations, interior finish, or other signs (refer to OSHA Standard 1910.37).

1.2.1.2. Doors, passageways, or stairways which are neither exits nor ways to an exit, but may be mistaken for an exit, will be clearly marked "NOT AN EXIT" or by a sign indicating their actual use, for example, "STORAGE ROOM" or "BASEMENT."

1.2.1.3. When the direction to the nearest exit may not be apparent to an occupant, an exit sign with an arrow indicating direction will be used.

1.2.1.4. Exit access will be arranged so it is unnecessary to travel toward any area of high hazard potential in order to reach the nearest exit (unless the path of travel is effectively shielded by suitable partitions or other physical barriers).

1.2.1.5. Nothing will be allowed to impair the visibility of the exit sign.

1.2.1.6. A door from a room to an exit or to a way of exit access will be the side-hinged swinging type. It will swing in the direction of exit travel if 50 or more persons occupy the room or the exit is from an area of high hazard potential.

1.2.1.7. Areas around exit doors and passageways will be free of obstructions. The route will lead to a public way.

1.2.1.8. If occupancy is permitted at night, or if normal lighting levels are reduced at times during working hours, exit signs will be suitably illuminated by emergency power as required by NFPA Standard 101.

1.2.1.9. No lock or fastening will be used which might prevent escape from inside the building.

1.2.1.10. Where occupants may be endangered by the blocking of any single exit due to fire or smoke, there will be at least two means of exit remote from each other.

1.2.2. Electrical. All electrical work, installation, and wire capacities shall be according to the pertinent provisions of NFPA 70, *National Electrical Code (NEC)*, unless otherwise modified by the provisions of this standard.

1.2.2.1. Only trained and qualified electricians will be permitted to install and maintain electrical equipment.

1.2.2.2. All personnel will know the location and on-off operation of the power control switches and stations in their work area. In addition, emphasis will be placed on the need to maintain clear, unrestricted access to these controls at all times. This knowledge is essential to disengage electrical circuits to equipment in the event of a fire or accidental electrical contact. All panels and control switches will be marked as to what they control, as required by the NEC.

1.2.3. Ventilation: (Refer to AFOSH Standard 48-2, *Industrial Ventilation*.)

1.2.3.1. Control of Vehicle Exhaust:

1.2.3.1.1. Local Engine Exhaust Ventilation:

1.2.3.1.1.1. The vehicle maintenance work area will contain a suitable exhaust ventilation system either under the floor with readily available adapter hoses or an overhead system arranged so the connecting hoses can be raised when not in use. In shop areas equipped with under the floor systems, adapters will be used on equipment having vertical exhaust stacks to allow the exhaust to be transmitted to the floor connections. Carbon monoxide (CO) concentration will be monitored by the installation bioenvironmental engineering (BE) personnel and levels kept less than the permissible exposure limits (PEL) listed in AFOSH Standard 48-8, *Controlling Exposures To Hazardous Materials*. The supervisor will ensure there is a proper calibration schedule for the analyzer.

1.2.3.1.1.2. Exhaust ducts will be protected against mechanical damage. In-floor units will be flush with the floor level when closed and capable of withstanding vehicle and equipment traffic. In-floor exhaust duct systems should be equipped with a fluid collection system that prevents drainage into the installation sanitary sewage systems. This might be accomplished by sump pumps, fuel and (or) oil separator, or a combination thereof dedicated to the collection system, or by routing the collected fluids to the shop's main drainage system. Overhead ducting shall be properly supported and afford adequate clearance to avoid damage from moving vehicles and equipment.

1.2.3.1.1.3. Ducting will be stowed, when not in use, in a way that prevents damage to the equipment and does not cause a hazard to personnel.

1.2.3.1.2. General Engine Exhaust Ventilation. Minimal general ventilation rates to be achieved by either natural or mechanical means are specified in AFOSH Standard 48-2. This ventilation is in addition to local exhaust ventilation and is required to remove exhaust gases generated when vehicles are moved around the shop and vapor evaporates from fuel systems.

1.2.3.2. General:

1.2.3.2.1. The following operations or processes may produce airborne contaminants that exceed PEL:

1.2.3.2.1.1. Spray painting, spray cleaning, solvent cleaning, or stripping operations.

1.2.3.2.1.2. Open surface tanks (dip tanks, etc.).

1.2.3.2.1.3. Welding, soldering, torch cutting, and metallizing.

1.2.3.2.1.4. Abrasive blasting operations.

1.2.3.2.1.5. Metal cutting, grinding, buffing, and polishing operations.

1.2.3.2.1.6. Machine shop operations (lathes, etc.).

1.2.3.2.1.7. Battery shops.

1.2.3.2.1.8. Open tanks on refueler vehicle.

1.2.3.2.1.9. Brake lining discs.

1.2.3.2.1.10. Clutch linings.

1.2.3.2.2. The vehicle maintenance supervisor will have these operations evaluated by the installation bioenvironmental engineer (BEE) and will keep documentation showing the

results of the evaluations and any corrective actions taken as a result of recommendations made.

1.2.3.2.3. Where operations or processes require that a ventilation system be used, the BEE will develop inspections to be accomplished by a qualified person (normally the supervisor). The inspection will vary in depth by the seriousness of the hazard involved. Frequency will not exceed 30 days. Documentation of the periodic inspection will be maintained by the supervisor. A general purpose form may be used. Wherever possible a visual indicator such as a gauge, manometer, etc., should be installed at a readily observable point so employees, supervisors, or inspectors can directly determine that systems are functioning properly.

1.2.3.2.4. The vehicle maintenance supervisor will contact the BEE if a deficiency exists in a ventilation system for a determination of what interim measures should be taken.

1.2.3.3. Quarterly Testing. The BEE will provide the results of the quarterly testing, required by AFOSH Standard 48-2, to the vehicle maintenance supervisor.

1.2.4. Static Grounding. Aircraft refuelers shall have a static ground system in serviceable condition. Refueling equipment within the refueler maintenance facility or when undergoing maintenance will be connected to a serviceable ground at all times, except when the vehicle is in motion. Refueling maintenance support equipment (SE) will be grounded. Storage bins will be grounded if located inside the shop. Ramp ground rods will be those with resistance values of 10,000 ohms or less. Static grounds do not need to be tested periodically after having been installed and after having met the resistance criterion, unless damaged. Any static ground which measures greater than 10,000 ohms will be removed or replaced. Test data will be maintained in the civil engineer facility files. Nozzle static grounding will be according to TO 37A-1-101, *General Instruction-Fuel, Water, and Lubricant Dispensing Equipment*. Only approved 75 amp ground clips (for example, National Stock Number (NSN) 5999-00-134-5844) will be used as listed in TO 37A-1-101. The use of alligator clips is prohibited to ground or bond aircraft and support equipment. Only ground wire specified by TO will be used in the shop or on refueling equipment. Ground cables will be inspected weekly for broken strands. Repaired or newly constructed grounding cable assemblies will be checked for continuity. Refueling maintenance personnel will check bonding devices on all aircraft refueling units and associated equipment to ensure they are properly bonded prior to use.

1.2.5. Machinery, Machine Guarding, Power Transmission Guarding, and Shop Equipment. AFOSH Standard 91-12, *Machinery*; OSHA 29 CFR 1910 Subpart O, *Machinery and Machine Guarding*; and OSHA 3067, *Concepts and Techniques of Machine Safeguarding*, will be consulted.

1.2.5.1. Supervisors will maintain technical data, to include the applicable 48- and 91-series AFOSH standards, for all machinery and shop equipment used in their area of responsibility.

1.2.5.2. Machinery and shop equipment will be maintained and operated by qualified personnel.

1.2.5.3. Machine guarding and power transmission guarding not covered in AFOSH standards will be according to OSHA 29 CFR 1910 Subpart O. All machinery guard and danger zones will be conspicuously identified.

1.2.5.4. No attempt will be made to clean any part of a machine until all moving parts have come to a complete stop. Chips or other particles will be removed by brushes or compressed air. If compressed air is used, the nozzle pressure at the discharge end of the air line will be less than 30 pounds per square inch (psi) and an effective means of preventing chips and particles from striking

the eyes and skin of the operator and other workers will be used. Eye and (or) face protection will be worn while using compressed air to clean machines. Effective methods of preventing flying chips and particles are screens, barriers, and protective cones attached to air nozzles. Compressed air will not be used to blow chips or other debris from a worker's body or clothing. Certain metallic dusts are extremely hazardous to inhale (lead, beryllium, cadmium, asbestos, etc.) and cleaning will NOT UNDER ANY CIRCUMSTANCES be accomplished using compressed air. Low volume - high velocity exhaust systems can be employed in certain instances. The installation BEE will be consulted for assistance.

1.2.5.5. Air compressors will be installed in a way that provides easy access to all drains, valves, and drives. A drain cock will be provided at the lowest point of the tank to provide for removal of water and metal particle accumulations. Air compressors should be located outside the work area whenever possible to minimize noise exposure.

1.2.6. Hand Tools, Portable Powered and Nonpowered:

1.2.6.1. The first factor of hand tool safety is that the tools are of good quality and designed for the job at hand. Further, all tools will be kept in good repair and maintained only by qualified personnel.

1.2.6.2. Specific criteria unique to a certain tool should be contained in the technical data requiring the use of the tool. To obtain required tools and equipment TO 32-1-2, *Use of Hand Tools*, will be consulted. Table of Allowance (TA) 403 and TA 457 and General Services Administration (GSA) catalogs should also be used to determine additional requirements necessary to accomplish a particular maintenance mission.

1.2.6.3. Portable powered tools will be procured to conform to military specifications (Mil Spec), if available. If Mil Specs applicable to a portable powered tool have not been published, the procuring document shall include a requirement for the tool to meet or exceed the requirements established by OSHA 29 CFR 1910.243, *Guarding of Portable Powered Tools*, and OSHA 29 CFR 1910.304, *Wiring Design and Protection*. Whenever possible, low noise power tools or tools with noise reduction attachments should be utilized. (AFOSH Standard 48-19, *Hazardous Noise Program*, will be referenced and the BEE will be consulted.)

1.2.6.4. Tools, when not in use, will be kept in suitable metal or fabric containers and not in pants or coat pockets. A hand power tool that is running will not be left unattended on a stand, the floor, or a vehicle.

1.2.7. Housekeeping. In vehicle maintenance facilities, housekeeping is a continuous operation. The very nature of the work being carried on gives rise to oil spillage, debris on work surfaces, and cleaning materials lying around. Motor vehicle maintenance activities, such as painting, welding, battery work, and tire and wheel maintenance will be carried out in separate parts of the shop where one kind of operation will not be hazardous to another.

1.2.7.1. Proper layout, spacing, and arrangement of equipment and machinery are essential. The installation ground safety manager, fire chief, BEE, and civil engineer will coordinate and approve all plans.

1.2.7.2. Suitable noncombustible containers with closing lids will be used for scraps, waste, rags, disposal of smoking materials, etc. Each container will be plainly marked to designate its contents. These containers will be emptied when full or at the end of each shift.

1.2.7.3. Floors will not be cleaned with flammable liquids. When toxic cleaning agents are used, adequate ventilation will be provided to remove vapors. Floors will be kept clean and spills immediately removed or barricaded off. Absorbent materials will be readily available and used on grease, oil, and hydraulic fluid or fuel spills. After absorbent materials have been applied to a spill, the floor will be thoroughly cleaned. If solvents and paints are required, adequate ventilation shall be provided. The BEE will be consulted to ensure ventilation meets criteria (refer to AFOSH Standard 48-2 for more detailed information). For infrequent paint use, respiratory protection will be utilized as required by the BEE (refer to AFOSH Standard 48-1, *Respiratory Protection Program*).

1.2.7.4. Floor surfaces will be cleaned as often as necessary to maintain a safe walking surface. Personal protective equipment (PPE) (to include as a minimum: eye protection, nonslip rubber boots, and rubber gloves) will be worn whenever toxic or hazardous materials are involved.

1.2.7.5. Hazardous materials will normally be removed and disposed of by a commercial disposal specialist who will comply with published environmental regulations. The installation environmental management personnel in the civil engineering organization will be contacted for assistance (also refer to AFI 32-7080, *Pollution Prevention Program*).

1.2.7.6. Beverages or food will not be stored or eaten in the work areas. Eating areas will be identified and approved by the functional manager.

1.2.7.7. Tools and parts will not be left on equipment or lying in aiseways. Suitable racks or cabinets will be provided for storage.

1.2.7.8. Smoking policy and control in the work area will be established by the functional manager and coordinated with the fire chief and safety staff. Signs will be posted where smoking is prohibited.

1.2.7.9. Drip pans will be used where a process, pieces of equipment, or maintenance operation being performed can result in liquid or grease dropping on the floor.

1.2.7.10. Floors in the shops will be constructed so they are sloped to drain and drains will be constructed so they are self-draining and equipped with an oil separator. Oil separators will be cleaned at a frequency determined by the installation civil engineer and (or) BEE. The shop supervisor will maintain the letter identifying the cleaning frequency and a locally developed record to show compliance. Drains will not be connected to sanitary sewers, except that the effluent from oil separators will be connected to sanitary sewers.

1.2.7.11. Electric cords and air hoses will not be left on the floor when they are not in use. They will be stored in designated places to prevent damage to the cord or hose and to eliminate tripping hazards. These items should be suspended from overhead in maintenance areas.

1.2.7.12. In areas where snow and ice conditions are present, personnel will keep walkways, emergency exits, and door openings (personnel and vehicle) free of snow and ice. If these areas become slippery, they will be treated with sand, ashes, calcium chloride, or other similar materials. Overhangs above personnel walkways or doorways and vehicle entrances and exits will be kept free of ice or snow that could fall and inflict injury to personnel or damage to equipment. Snow removal equipment and special vehicles that collect large amounts of snow and ice will be brought into the shop and snow or ice allowed to melt before repairs are started. In instances where this is not practical, the vehicles will be washed with water to remove snow and ice. Snow and ice

deposits from each vehicle will be washed down the floor drains before work is started or another vehicle is moved into the area. In areas where performing maintenance on vehicles during winter months causes constantly wet floors, the floor surface should be nonskid.

1.2.7.13. Shop entrances and exits will be clearly marked and lighted to prevent mishaps at these locations. Door frames and door edges of vehicle shop entrances should be marked with reflective tape, painted, or highlighted in yellow and black to make them easier to see after dark. Appropriate traffic signs should be posted at entrances and exits. In the interest of safety, a maximum speed limit of 5 miles per hour should be enforced in and around shops. The operator will sound the vehicle horn prior to entering or exiting facilities to alert nearby personnel.

1.2.8. Spills: (All fuel spills should be reported and handled according to local contingency plans.)

1.2.8.1. Fuel Spills. If a fuel spill or severe petroleum leak occurs in the vehicle maintenance area with drainage into a fuel separator, all maintenance operations will immediately cease. All affected personnel will immediately evacuate the area and the fire department will be notified. No one will be permitted to return to the area until the spill is diluted, evaporated, or absorbed. Workers should avoid any action that could provide an ignition source for fuel vapors. Fuel-saturated clothing shall be removed outside the area. The skin will be thoroughly washed with soap and water if fuel is splashed or spilled onto it. Clothing will be flushed with water in a well-ventilated area where the fuel and vapors will not pose a hazard. Clothing contaminated with fuel will not be placed in lockers or other confined areas, since vapors from fuel can be trapped in clothing. If the vapors are ignited, the resulting fire is difficult to extinguish and causes severe burns to the person involved.

1.2.8.2. Oil and Hydraulic Fluid Spills. The agency responsible for the spill will remove it using compound, oil, and water absorbent (NSN 7920-00-269-1272 or equivalent)—the approved method. Fire protection equipment shall not be used when removing oil and hydraulic fluid spills.

1.2.8.3. Sanitary Sewers. Every effort will be taken to preclude spilling petroleum products into sanitary sewers because this can affect sewage treatment facilities. If resulting spillage does enter the system, the installation fire department, civil engineering, and BE officials will be notified. If fuel spills are washed down floor drains, sufficient water will be used to be certain that all fuel has been flushed from the drainage system. Before using large amounts of water to flush the fuel, supervisors will ensure proper containment measures are available to prevent an environmental pollution incident in a receiving stream.

1.2.9. Flammable Liquid Storage:

1.2.9.1. The storage, use, and handling of flammable and combustible liquids will be according to AFOSH Standard 91-43, *Flammable and Combustible Liquids*, and in coordination with the installation fire department officials.

1.2.9.2. The type of cabinet, location, type of materials, and quantities will be coordinated with the installation fire department officials.

1.2.9.3. The storage cabinets shall be conspicuously labeled "FLAMMABLE - KEEP FIRE AWAY" (refer to OSHA 29 CFR 1910.106, *Flammable and Combustible Liquids*).

1.2.9.4. Fuels will not be used to clean floors, clothing, hands, or parts. Fuels or solvents will not be used as cigarette lighter fluid.

1.2.10. Fire Prevention. The installation fire chief will be consulted for specific shop requirements.

1.2.10.1. Open Flames:

1.2.10.1.1. Flame-producing equipment will not be used in refueler maintenance shops. Other vehicle maintenance shops may use flame-producing equipment if all safety procedures are followed and the requirements in AFOSH Standard 91-5, *Welding, Cutting, and Brazing*, are complied with.

1.2.10.1.2. The welding shop will be properly identified as such, and approved by the fire chief and the safety staff for open flame activities.

1.2.10.2. Low Flashpoint Solvents. Supervisors in charge of operations where solvents, lubricants, or other flammable liquids are used, will be constantly alert to avoid the use of low flashpoint petroleum solvents. Efforts will be made to obtain and use non-flammable solvents when practical. Other items that will be avoided in the presence of flammable or combustible liquids are open flames, open-element heaters, equipment not properly grounded, and use of nonexplosion-proof electrical equipment.

1.2.10.3. General Fire Extinguisher Requirements:

1.2.10.3.1. The area supervisor shall ensure personnel are trained annually on the location, selection, and use of fire extinguishers, electrical power disconnecting locations, alarm systems, evacuation procedures, and installed fire protection systems. The installation fire department, Technical Services Branch personnel will provide assistance upon request. The training will be documented on AF Form 55, *Employee Safety and Health Record*, according to AFI 91-301.

1.2.10.3.2. Fire extinguishers shall meet the following requirements (refer to AFOSH Standard 91-56, *Fire Protection and Prevention*, for further guidance):

1.2.10.3.2.1. They are in proper operating condition and in their designated places.

1.2.10.3.2.2. They are not obstructed or obscured from view. In locations where visual obstructions cannot be completely avoided, contact the local fire department.

1.2.10.3.2.3. They have not been tampered with or activated.

1.2.10.3.2.4. They do not have external corrosion or other impairments.

1.2.10.3.2.5. They are suited to the specific needs of the location.

1.2.11. Illumination. At least 50 foot-candles of illumination will be maintained at a worker's position. Where necessary, additional artificial lighting will be supplied. The installation BEE will be consulted for further guidance on illumination levels.

1.2.12. Occupational Health:

1.2.12.1. The BEE will identify hazardous noise areas and recommend appropriate control or protective measures according to AFOSH Standard 48-19. Newly acquired equipment which generates potentially hazardous noise should be evaluated by the BEE prior to its routine use.

1.2.12.2. When noise level surveys have identified a need for hearing protection, ear plugs, ear muffs (or both) will be provided to all personnel and their use will be strictly enforced. Prior to employees using ear plugs, the supervisor will ensure the ear plugs are fitted for the individual.

Emphasis also will be placed on personnel not actually involved in the work, but who are within the area and may be affected by the noise. The BEE will be consulted for assistance on noise problems.

1.2.12.3. Stationary internal combustion engine-driven equipment will not be operated inside buildings unless an exhaust system, approved by the BEE, is installed and used. When equipment is operated adjacent to buildings, the exhaust will be directed away from the building. Air flow will be adequate to provide fresh air and prevent the accumulation of JP-4, gasoline, and other hydrocarbon vapors, and carbon monoxide (refer to paragraph 1.2.3. for additional information).

1.2.12.4. JP-4, JP-5, and other jet engine fuels containing toxic aromatics will be handled with the same caution as gasoline.

1.2.12.5. Protective hand creams are available and should be used by personnel engaged in cleaning parts. These creams are not substitutes for proper PPE such as gloves, but rather are additional protection in case of inadvertent skin contact with cleaning solvents. Protective gloves will be worn by shop personnel engaged in this operation. A protective face shield will be worn when compressed air is used to clean carburetor orifices. The air pressure will be regulated below 30 psi.

1.2.12.6. Good personal hygiene is important in maintenance shops. Clothing will be changed when contaminated with solvents or fuels and not stored. No food or drink will be consumed in shop areas. Shop personnel shall wash their hands before eating. Vented lockers with separate compartments for clean and soiled clothing will be provided.

1.2.12.7. Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes or body shall be provided within the work area for immediate emergency use. A water hose may **NOT** be used to meet the requirements in this paragraph. Medical attention will be obtained as soon as adequate flushing and drenching of the eyes or body has been accomplished. Supervisors may contact the BE and (or) installation ground safety officials for assistance in determining how to meet the requirements of this paragraph (refer to AFOSH Standard 91-32, *Emergency Shower and Eyewash Units*).

1.2.13. Manual Handling. Fixed weight limits for men and women to lift manually are difficult to prescribe because of physical differences, both within each sex and between the sexes. Also, the size, shape, weight of the object to be lifted (and distance to be moved) are influencing factors. To generalize, a weight of approximately 40 pounds for the average woman and 60 pounds for the average man are the maximum weights that should be manually lifted. For weights greater than this, additional help will be sought or mechanical assists used. Proper lifting techniques are as important as the weight of the object to be lifted. Supervisors will ensure their personnel receive thorough instructions in proper techniques to use in safe lifting and carrying procedures and in the use of PPE. Manual lifting training will be documented on AF Form 55. Gloves shall be worn to lift objects which have sharp or burred edges or splintered surfaces.

1.2.13.1. Before an object is lifted, it should be inspected to make certain no grease or slippery substance will cause the object to slip. To lift properly:

1.2.13.1.1. Position Feet Correctly. Place feet shoulder width apart for balance, with one foot to the rear of the object and the other foot slightly ahead of the other and to the side of the object (**Figure 1.1.**).

Figure 1.1. How to Lift Properly.



1.2.13.1.2. Crouch Close to the Load. Crouching is preferred to squatting. Stay close to the load to minimize strain on the back muscles (**Figure 1.1.**).

1.2.13.1.3. Back Straight. Always keep the back as straight as possible. It may not be possible to keep the back in the vertical plane but avoid arching the back. Bend from the hips and not from the middle of the back (**Figure 1.1.**).

1.2.13.1.4. Full Palm Grasp. Pick up materials with a full palm grip. Do not attempt to pick up weights with a fingertip grip. Ensure the load is free of grease or sharp points which could cause injury. Use suitable gloves when necessary.

1.2.13.1.5. Kinetic Leg Lift. With the arms, slide the object toward the body to give it some motion (kinetic energy). At the same time, lift the object with the legs and bring the back to a vertical position. Keep the object close to the body while lifting.

1.2.13.1.6. Setting the Object Down. Use the same method as when lifting, but reverse it to set an object down. Lower the load by bending the legs and squatting with the back straight. Take care when releasing the load to prevent injury to fingers, hands, or feet. Release grip when the load is securely positioned.

1.2.13.2. Points to remember:

1.2.13.2.1. Use gloves to protect the hands and safety shoes to protect the feet.

1.2.13.2.2. Inspect objects for slivers, sharp edges, rough surfaces, or slippery surfaces before attempting to lift.

1.2.13.2.3. Keep fingers away from pinch and shear points.

1.2.13.2.4. Do not carry a load that obstructs the view of the direction of travel. Make sure the path of travel is clear.

1.2.13.2.5. Do not turn at the waist to change direction or to put an object down. Turn the whole body and crouch down to lower the object.

1.2.13.3. Where the load or material is too much for one person to handle safely, and mechanical equipment is not practical for this purpose, additional workers shall be assigned to assist in the job. Workers of approximately the same size should be used and they should be trained in team-lifting. If one worker lifts too soon, shifts the load, or lowers improperly, either the worker or partner may be overloaded and strained. One person should be assigned to giving orders to ensure the necessary coordination.

1.2.13.4. Mechanical material handling equipment will be used whenever loads are too heavy or bulky to be lifted or carried efficiently or safely by hand. Forklifts, hand trucks, rollers, conveyors, or cranes (when properly used) simplify materials handling and greatly reduce the hazards of handling supplies and equipment.

1.2.14. First Aid. If hydrocarbon fuels are splashed or spilled onto personnel, the following steps shall be taken:

1.2.14.1. Remove contaminated clothing as soon as possible and wash affected skin areas with soap and water. Launder contaminated clothing before wearing again. Do not place contaminated clothing in lockers or other confined spaces. Hang in a safe area away from fire and heat and allow to air dry.

1.2.14.2. If fuel is splashed into the eyes, immediately flush the eyes with water continuously for at least 15 minutes; then seek medical attention.

1.2.14.3. If fuels are swallowed, do not induce vomiting. Seek medical assistance as soon as possible.

1.2.15. Personal Protective Equipment (PPE). PPE may not be used as a substitute for feasible engineering or administrative controls. While these controls are being implemented, or if it has been determined that control methods are not feasible, PPE is required whenever there are hazards that can do bodily harm through absorption, inhalation, or physical contact. This equipment includes respiratory and hearing protective devices, special clothing, and protective devices for the eyes, face, head, and extremities. All PPE will be of safe design and constructed for the work to be performed and will be maintained in a sanitary and reliable condition. Requirements for PPE will be coordinated by the supervisor with the installation ground safety and BE officials (refer to AFOSH Standard 91-31, *Personal Protective Equipment*, for additional information).

1.2.15.1. Eye and (or) face protection is required where there is a possibility of injury from caustic cleaning materials and flying particles, splatters, or chips.

1.2.15.2. Refer to paragraphs 1.2.12.1. and 2. for information on hearing protection.

1.2.15.3. Some cleaning materials or operations may require the use of PPE. Equipment required could range from boots, aprons, and gloves — to face shields or even respirators. When sufficient guidance is not available, the installation ground safety or BE personnel should be contacted for guidance.

1.2.15.4. Non-skid shoes shall be worn by personnel working in areas where floors may become wet or greasy. Safety-toe footwear shall be worn when performing work in the vehicle maintenance shops.

1.2.15.5. Protective gloves shall be provided when employee’s hands are exposed to rough, hot, cold, or sharp objects or when continual handling may produce blisters.

1.2.15.6. If the presence of asbestos is suspected, compressed air shall not be used to clean clutch and brake assemblies; vacuuming will not be accomplished unless a high-efficiency particulate air (HEPA) vacuum filter is installed. The clutch and brake assemblies should be wiped with a damp rag and the rag disposed of as directed by the BEE. The BEE will be consulted if in doubt (refer to AFOSH Standards 48-1 and 48-8).

1.2.15.7. Respiratory protection is required if prolonged breathing of chemical vapors, mist, or fumes is expected or if working in confined space when the atmosphere is oxygen deficient. Supplied breathing air system with quick access emergency egress air supplies may be needed. The BEE will be consulted for additional information (refer to AFOSH Standard 48-1).

1.2.15.8. Exposure to high concentrations of tetraethyl lead (TEL) should be avoided. The BEE will be consulted about the health hazards of TEL.

1.2.15.9. PPE will be kept clean and, if not individually issued, will be prominently displayed and (or) stored in the immediate vicinity where its use is required.

1.2.15.10. The vehicle maintenance supervisor will ensure all personnel are trained in the care and use of PPE and will enforce its use.

1.2.15.11. **Table 1.1.** lists frequently occurring operations where the use of PPE should be locally evaluated. The list is not all inclusive and local supervisors may need to identify additional work situations (refer to AFOSH Standard 91-31 for additional guidance).

Table 1.1. Frequently Performed Vehicle Maintenance Operations Where PPE May Be Required.

NOTE: Installation management, ground safety, and BE representatives should be consulted to determine PPE requirements for tasks not covered.

Operations	Type PPE
Battery Handling	Eye protection (side and frontal) Acid resistant gloves Arm gauntlets or extended length gloves Acid resistant apron Acid resistant shoes or boots (only when performing battery maintenance)
Body Shop	Gloves Face shield and (or) goggles Respiratory protection may be required during sanding operations—consult the BEE

Operations	Type PPE
Brake Shop	Respiratory protection—consult the BEE
Cleaning Tank	When processing parts in cleaning tank: Eye protection Respiratory protection may be required—consult the BEE Apron Gloves Boots
Compressed Air Cleaning	Eye protection or face shields
Machinery and Grinders	Eye protection and (or) face shields Respiratory protection may be required—consult the BEE
Mobile Maintenance	Eye protection and (or) face shield Gloves Baking soda (not PPE, but it should be available)
Paint Shop	Protective clothing Respiratory protection may be required—consult the BEE Eye protection Rubber gloves
Radiator Shop	During boiling out operation: Eye protection Gloves
Refueler Vehicle Maintenance	Cotton/polyester uniform (50/50) Non-sparking safety shoes Respiratory protection may be required—consult the BEE
Repair Pits	Eye protection Head protection Rubber boots Gloves as appropriate

Operations**Type PPE**

Soldering

Vented goggles

Face shield

Head covering (when soldering overhead)

Tire Shop

Gloves

Eye protection

Foot protection

Hearing protection

Welding

Eye and face protection

Head protection (when welding overhead)

Foot protection

Flame resistant clothing, leather protection for clothing

Gloves

Apron

Welder's goggles or welding helmet—refer to AFOSH Standard 91-5 for lens shade requirements

Respiratory protection (may not be required when adequate exhaust ventilation is used—consult the BEE)

NOTE: Safety goggles, face shield, safety glasses (glasses with shatterproof lens and side protector shields) or a combination thereof, will be worn during operations requiring the use of power and (or) hand tools where airborne fragments of the tool and (or) work material may become projected at the eyes, face, or neck. These operations include, but are not limited to, drilling, grinding, chipping, cutting (with chisel), sandblasting, and scaling metals. Approved eye protection is mandatory while using stone or wire wheel grinders regardless of whether or not eye shields are installed.

Chapter 2

BATTERY MAINTENANCE

2.1. General Requirements . The facilities will conform to the provisions of the NEC. Article 480 and (or) 500, OSHA 29 CFR 1910.178, *Powered Industrial Trucks*, and this standard. Lead acid and nickel-cadmium (nicad) batteries shall be maintained in separate rooms or areas. A battery room or area is the place where batteries are maintained and stored. They are designed to meet specific requirements to reduce and remove certain hazards associated with battery maintenance. Receptacles and lighting switches should be located outside the battery area. The lighting fixtures shall be protected from physical damage by guards or isolation. The storage batteries shall be located within a protective enclosure or area accessible only to qualified persons.

2.2. Specific Requirements :

2.2.1. Ventilation. The battery area shall be ventilated, either by a natural or powered ventilation system, for dispersal of airborne contaminants from gassing batteries (refer to AFOSH Standard 48-2).

2.2.2. Emergency Eyewash. Emergency eyewash and (or) water facilities for rinsing eyes and skin shall be provided in the battery charging areas (refer to AFOSH Standard 91-32).

2.2.3. Warning Signs. Signs prohibiting smoking, sparks, or flame will be posted inside and outside the battery room.

2.2.4. Installation and Care of Batteries:

2.2.4.1. Proper installation and care of batteries is essential to ensure maximum life and performance. Batteries should always be installed in a level position. Excessive tightening of holddown brackets can distort or crack the battery case. Cable clamps should not be pounded on battery terminals, but should be spread until they can be seated properly. Battery tops should be free of dirt and moisture to prevent self-discharge of battery. When removing a battery from a vehicle, the battery ground cable will be disconnected FIRST to prevent the possibility of a spark. Upon reinstallation, the battery ground cable will be installed and tightened LAST to prevent a short or spark and possibly an explosion. **CAUTION:** Some vehicles have two or more batteries, hooked in parallel, with one or more of the batteries remotely located (e.g., the 1985 Chevrolet flightline van has one battery in the engine compartment and one under the driver's seat). When the positive and negative cables are removed from the one battery, the spark potential still exists until the ground cable has been removed from the other battery.

2.2.4.2. Personnel engaged in battery maintenance will:

2.2.4.2.1. Not wear rings, watches, bracelets, or other jewelry made of electrically conductive materials. Secure metal eyeglasses by a band or cord.

2.2.4.2.2. Use straps for lifting and carrying batteries. If straps cannot be used, exercise extreme caution when lifting to prevent strain, particularly when removing batteries installed in vehicles. Use two people to handle batteries located in places that put a person in an awkward position when the battery is being handled.

2.2.4.2.3. Use mechanical lifting devices when handling batteries that cannot be safely handled by two people. Equip chain hoists that are used to handle batteries with a chain container

or bucket to prevent the dangling chain from shorting out a battery. If, when using a chain hoist, it appears the possibility of shorting out a battery exists, then cover the battery with a non-conducting material such as a piece of plywood.

2.2.4.2.4. Take precautions when handling batteries not to short the battery terminals together.

2.2.4.2.5. Ensure tools and other metallic objects are kept away from the top of uncovered batteries and stored in positions so they will not fall on batteries.

2.2.4.2.6. Wear PPE as follows:

2.2.4.2.6.1. When servicing (cleaning batteries, battery connection points and (or) cables, servicing fluid level, connecting or disconnecting a battery charger at the battery, or jump starting) a battery installed in a vehicle or piece of equipment, eye protection that affords protection from the sides as well as the front will be worn. When handling electrolyte, a face shield and acid resistant gloves and apron will be worn.

2.2.4.2.6.2. When otherwise handling batteries (removing or installing in vehicles or equipment or transporting them) or when working in the battery room or maintenance area, personnel will wear acid resistant gloves, arm gauntlets, aprons, and eye and (or) face protection. The eye and (or) face protection will provide protection from the side as well as the front. Acid resistant safety shoes or acid resistant rubber knee length safety cap boots may also be worn (refer to AFOSH Standard 91-31).

2.2.5. Protection Against Explosive Hazard. It should always be assumed an explosive mixture of gases exists in and around batteries, unless positive steps have been taken to eliminate them. For this reason, anything that could ignite these gases will be prohibited when working with batteries. The following are considered to be ignition sources and will not be permitted in the vicinity of batteries:

2.2.5.1. Matches or lighters will not be used when inspecting vent openings (refer to paragraph 2.2.3.).

2.2.5.2. Open flames from cutting torches or sparks from arc welding equipment (refer to paragraph 2.2.3.).

2.2.5.3. Smoking (refer to paragraph 2.2.3.).

2.2.5.4. Sparks from different sources could ignite the explosive mixture of gases that may be present in or around batteries (refer to paragraph 2.2.3.). The following are practices that should be avoided:

2.2.5.4.1. Sparks from shorting out a battery with tools or metal objects.

2.2.5.4.2. Sparks from connecting or disconnecting batteries while they are in use. This is likely to happen when a second battery is connected to the battery to help start a vehicle with the use of jumper cables.

2.2.5.4.3. Sparks from disconnecting (or connecting) a battery from a charger before turning the charger off.

2.2.5.4.4. Sparks created while a battery is being removed from or installed in a vehicle when current is flowing in the battery circuit.

2.2.5.4.5. Sparks occurring when a wrench is being used to remove a cable from the battery post.

2.2.5.4.6. Sparks occurring during vent cap removal. To avoid this, any concentration of combustible gases should be flushed out of each cell with a gentle stream of air. This can be safely accomplished by fanning each vent opening with a stiff piece of cardboard or other suitable non-conductor.

2.2.5.4.7. Sparks or short circuits in the presence of flammable or combustible liquids. If installing or replacing electrical components in the presence of flammable or combustible liquids, the worker will disconnect the battery ground cable. This will deactivate the vehicle's electrical system, preventing accidental short circuits or sparks that might occur should a screwdriver or other metal tool be accidentally touched to the wrong electrical terminal.

2.2.5.4.8. Sparks occurring when cleaning batteries or terminals. The terminals will never be cleaned with metal brushes or other metal devices which may contact both terminals and short circuit the cells.

2.2.6. Vent Cap Maintenance. The vent caps on top of a battery are designed to help keep the electrolyte (or chemical paste) within the battery and to keep dirt out. The vent caps should be kept clean and firmly in place to avoid electrolyte spray. (Vent caps are sometimes removed because of tech data requirements on specific batteries.)

2.2.7. Battery Safety Practices. Note that while the special construction and application of automobile batteries may require special emphasis on certain safety practices, the basic safety practices of all lead-acid batteries are the same and only vary in emphasis with specialized construction or conditions of use. Therefore, it should be understood that guidance given for one type of battery usage can and should be followed with other usages when applicable. Precautions should be taken to service nickel cadmium and silver-zinc batteries in an area isolated from lead-acid batteries. Sufficient ventilation should be provided to prevent acid gases or mists from entering the nickel-cadmium or silver-zinc battery area. When both acid and potassium hydroxide electrolyte batteries are handled in the same shop, specific equipment for the two kinds of batteries should be kept separate and carefully labeled. Implements which have been used to service nickel-cadmium alkaline, silver-zinc, or nickel-iron alkaline batteries should be used on those types only.

2.2.7.1. Battery Jump Start — Lead-Acid Batteries:

2.2.7.1.1. Jump starting is often used and it can be dangerous to the worker and harmful to the vehicle electrical system, unless it is accomplished in the preferred (safest) manner as follows: (**NOTE:** Proceed from step 1 through 4 of **Figure 2.1.** in sequence.)

2.2.7.1.1.1. Ensure both vehicles have identical electrical systems (for example, both are 12-volt negative ground).

2.2.7.1.1.2. Position the vehicles close but not touching, gear selector in **Park** (neutral on stick shift vehicles), parking brakes **ON**. **CAUTION:** Eye protection is required before proceeding to the next step.

2.2.7.1.1.3. Connect one end of the positive booster cable to the dead battery (refer to step 1, figure 2.1.) and the other end of the positive booster cable to the positive terminal of the good battery (refer to step 2, **Figure 2.1.**).

2.2.7.1.1.4. Connect the negative booster cable to the negative battery terminal of the car with the good battery (refer to step 3, figure 2.1.). (Again, use steps 1 through 4).

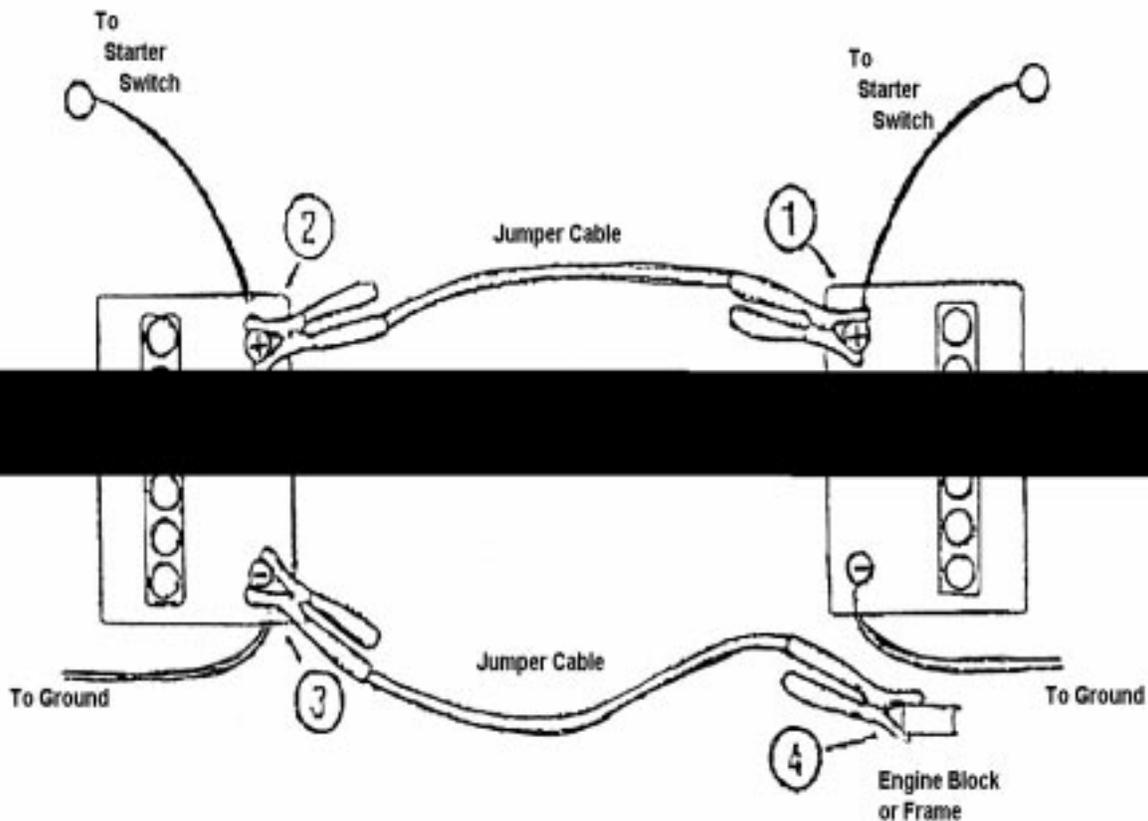
2.2.7.1.1.5. Connect the other end of the negative booster cable to the car frame, engine block, or other good metallic ground (not the carburetor or the fan), at a distance away from the dead battery. Do not connect it to the negative battery terminal of the discharged battery, because a spark could cause the battery to explode (refer to step 4, **Figure 2.1.**).

2.2.7.1.1.6. Start the engine of the vehicle having the good battery.

2.2.7.1.1.7. Start the engine of the disabled vehicle.

2.2.7.1.1.8. Remove the battery cables in the reverse order from which they were attached, being careful to keep hands and clothing away from moving parts such as the fan and belts.

Figure 2.1. Jump Start Diagram.



2.2.7.1.2. Following are do's and don'ts for jump starting:

2.2.7.1.2.1. If the worker does not understand how to jump start, he or she should not attempt the task, but should get someone who knows how to do it for them. For all government vehicles, the jump starting procedures should be accomplished by qualified vehicle maintenance personnel.

2.2.7.1.2.2. Workers will be advised that there is no smoking allowed during the operation.

2.2.7.1.2.3. The worker should make sure he or she knows which is the positive and which is the negative terminal on both batteries (workers will NOT connect plus (+) to minus (-) or minus (-) to plus (+) when jump starting). If the connections are made improperly, the results will be a large flaming spark, which could cause both batteries to explode.

2.2.7.1.2.4. The worker will grasp the booster cables by the insulated handles, never by the bare metal ends.

2.2.7.1.2.5. If battery acid comes in contact with the skin, the worker should immediately flush the skin with large quantities of cool water. If acid is splashed into the eyes, they will be flushed with large quantities of cool water for at least 15 minutes. The worker should seek medical aid.

2.2.7.1.2.6. The worker will not place his or her head close to the battery when connecting booster cables.

2.2.7.1.2.7. Workers will not wear jewelry (rings, watches, necklaces) that could come into accidental contact with the battery terminals and subsequently cause electrical burns. Metal eyeglasses will be secured by a band or cord.

2.2.7.2. Sealed Automotive Batteries:

2.2.7.2.1. There are several areas of consideration for sealed automotive batteries. The most severe hazard associated with these batteries concerns damage to the case, thus allowing the electrolyte to spill. Care will be exercised in handling and storage in order to prevent damage to the cases. Also, since the electrolyte contains a certain amount of water, batteries are subject to damage in freezing temperatures. The temperature at which the batteries will freeze is dependent on the electrical charge on the battery. The lower the charge the higher the temperature for freezing.

2.2.7.2.2. Sealed batteries received during cold weather, or that cannot be disposed of during warm weather, should be stored in heated or protected storage areas to avoid broken cases and contamination of storage areas from electrolyte spill caused by freezing.

2.2.7.2.3. Care will be taken when handling broken cases to avoid the possibility of acid burns from spilled electrolyte. When handling damaged batteries, a face shield, apron, and acid resistant gloves will be worn.

2.2.7.3. Industrial Batteries:

2.2.7.3.1. Lead-acid batteries are usually classified according to their usage. Just as the automobile starting battery is used primarily for starting engines, the industrial motive power battery provides the power for operating materials handling vehicles such as fork-lift trucks, platform trucks, and many other specialized equipment.

2.2.7.3.2. Motive power batteries, as a class, vary widely in the number of cells, size, weight, and configuration. A single battery unit encased in a steel tray can weigh as much as 12,000 pounds and approach the size of a double bed. The smaller batteries of this class may weigh only several hundred pounds and approximate the size of a suitcase. Handling batteries of this

size is quite different from handling automobile batteries and should not be attempted without proper equipment.

2.2.7.3.3. If the weight of a battery is not known and it cannot be weighed, the battery manufacturer should be consulted. The battery weight is usually stamped on the steel tray near one of the lifting ears. This weight is posted by the battery manufacturer at the time of shipment and is representative of the service weight of the battery at that time.

2.2.7.3.4. One of the functions of a battery in most industrial truck applications is its use as a counterweight for a carried load. A replacement battery should never be installed when its service weight is not within range of battery weights marked on a truck nameplate. Not adhering to this principle could result in changing the location of the center of gravity, which could result in upsetting a loaded truck.

2.2.7.3.5. Batteries encased in steel trays have lifting holes by which the battery may be moved. The lifting device provided should be designed to allow vertical lifting stresses on the battery tray. Lifting batteries with two chains attached to a hoist at a single central point (to form a triangle with the battery) is an unsafe practice. Not only does the safe load capacity of a double sling decrease as the angle increases, but the angular stress on the lifting ear of the battery reduces the built-in safety factor, and it increases the tendency for the hook to tear out the steel over the ear. A properly insulated spreader bar of ample size should be used with any overhead hoist.

2.2.7.3.6. Before a battery is removed from a truck, or is recharged in a truck, the electrical circuit of the truck should be open, the battery unplugged from the truck, and the brakes set or the wheels chocked. Only personnel who are trained and authorized should be permitted to change or recharge a battery. When moving a battery from a truck to a recharging location by overhead crane, the battery should not be pulled or led by the battery cables. Personnel will not stand under suspended loads.

2.2.7.3.7. When an enclosed battery (one with a cover) is charged, the cover of the steel tray of the battery should always be kept open throughout the entire recharging period. If a battery remains in the truck for recharging, the battery compartment cover of the truck should also be kept open throughout the entire recharging period. This will help promote cooling of the battery and allow better dispersion of the gases liberated during the recharging process. On larger batteries when the cover is divided in several independent sections, care should be taken to see that all sections are kept open during the recharging process. Excessive charging of lead-acid should not be permitted, as hydrogen gas is generated which creates a highly explosive gas mixture in the shop's atmosphere. A lead-acid battery should not be disassembled when taken directly from the charger. Work should not be done immediately on a battery which has run down under heavy load. In either case the battery may be gassing rapidly and may explode if heat is applied.

2.2.7.4. Indoor Battery Charging. Charging will be done in specifically designated areas. The local BEE will determine the ventilation needs for the charging area or room and the design criteria will be according to AFOSH Standard 48-2. Methods will be provided for flushing and neutralizing spilled electrolyte from work areas where batteries are serviced. The installation safety officials will determine the emergency eyewash and deluge shower needs. Limited-scale battery shops should have ready sources of running tap water with a hose provided for washing the work

area. This will also be coordinated with the local BE and Civil Engineering officials. Floors shall be of acid resistant construction or be protected from acid accumulations.

2.2.7.4.1. Racks. If racks are used for support of batteries during charging, the racks will be made of (or be coated or covered with) materials that will not contribute to the generation of sparks. Metal racks will be protected with acid resistive coatings and the actual supports on which a battery rests will be made of non-conductive materials or be suitably insulated. A low rack (close to the floor) will facilitate battery handling and proper maintenance. Racks will be designed to permit free access for servicing batteries.

2.2.7.4.2. Chargers:

2.2.7.4.2.1. Chargers will be turned off before the battery is connected or disconnected. Workers will be sure to check this each time. Failure to follow this practice can cause sparks and arcing if current should flow in the circuit and cause undesirable pitting of the contact surfaces of the mating plugs or connectors. Connections between a battery and a charger should be through a mating plug or connector assembly similar to that used between the battery and a truck. These connectors are polarized to help prevent damage to a battery from accidental discharging.

2.2.7.4.2.2. Some multiple battery and charger installations are equipped with polarized connectors of identical form on the battery and charger cables. Therefore, it is necessary to trace each plug or connector assembly back to its original source to ensure the correct interconnection between the battery and its charger and to prevent the inadvertent interconnection between two batteries or two chargers.

2.2.7.4.2.3. The contact surface of mating plugs or connectors used on trucks, batteries, and chargers will be maintained in good condition to avoid pitting or oxidation, which may cause a high-resistance contact condition. Such a condition can result in a decrease of voltage delivered to the truck, with the possible ultimate result of premature or sudden stopping of a vehicle. This could be considered a hazard if rapid or instantaneous withdrawal from a hazardous location is required at a time of contact failure.

2.2.7.4.2.4. Visual inspections are usually sufficient to determine the condition of contacts, which should be replaced if they show evidence of oxidation or pitting. Excessive heating of current-carrying parts in use can also be a signal of a poor electrical contact, which should also be investigated.

2.2.7.4.2.5. Because the potential across the battery plug contacts is the nominal voltage of the battery, any work on these parts will include precautions to avoid shorting out the battery.

2.2.7.4.2.6. Due to the hazards involved with diffused gases, work will not be implemented on batteries while they are on charge, or being discharged.

2.2.7.4.2.7. Before working on charger plug contacts, workers will ensure chargers are disconnected from the alternating current (AC) input power source. Truck plug contacts are safe to operate when the battery is disconnected, because the power circuit is dead.

2.2.7.4.2.8. At some installations, batteries of several different voltages may be in use and may be handled at the same battery recharging location. In these cases, special care will be taken to make sure batteries are charged only on those chargers of matching output volt-

age. When batteries of different voltage have polarized battery plugs or connectors that are of different types and do not mate, little danger of a mix-up can occur. But, if the battery connectors are the same, other steps should be taken. Some connectors are available in various colors to identify a series of integral, mechanical interlocks while others can be field-equipped with interlocking voltage keys to avoid improper voltage connections. If interlocking devices are not available, consideration should be given to another means of identification such as color or number-coding.

2.2.7.4.2.9. Chargers should be located in the battery charging area to afford ample ventilation and protection from damage by movement of trucks or batteries. Charger leads will be kept off the floor and out of aisles, especially when not in use, to avoid damage and creation of tripping hazards. Overhead leads should be plainly marked and be high enough to keep personnel from walking into them.

2.2.7.4.2.10. A carboy tilter or siphon shall be provided for handling electrolyte.

2.2.7.4.2.11. When charging batteries, acid shall be poured into water; water shall NOT be poured into acid. When water is poured into acid, a severe reaction occurs and splattering of acid usually occurs which can cause acid burns on exposed personnel.

2.2.7.4.3. Ventilation:

2.2.7.4.3.1. Ventilation in battery charging rooms should be sufficient to keep batteries and chargers from overheating and it should conform to applicable local codes and ordinances. The BEE will be consulted for guidance on ventilation requirements.

2.2.7.4.3.2. Floor fans with explosion-proof motors can aid in keeping battery temperatures from rising above 120 degrees Fahrenheit (F). Batteries should never be operated on charge or discharge at temperatures above 120 degrees F if normal service life is expected.

2.2.7.4.4. Disposing of Electrolyte. Procedures for disposal of electrolyte will follow approved civil engineer environmental controls and should be coordinated with the Civil Engineering and the BE officials.

2.2.8. Exit Door. Battery room doors shall swing outwards.

Chapter 3

CLEANING OPERATIONS

3.1. General Requirements :

3.1.1. A metal tank or container approved for flammable or combustible liquid will be used to immerse articles or materials for the purpose of cleaning, finishing, treating, or similar processes whenever flammable cleaning materials are used. Care will be taken to avoid solvent spillage.

3.1.2. Due to the exceptional low flashpoint values of solvents, care will be exercised in the correct selection of solvents to be used for cleaning operations. The lower the flashpoint value the higher the susceptibility to ignition at low temperatures. The flashpoints of various solvents differ widely due to their properties; these properties determine the flammability, thus a differentiation of Petroleum Distillate (PD) 680 solvents. There are two types of PD 680 solvents. Although both groups are closely related and somewhat similar, they are by no means identical and should not be confused. For example:

3.1.2.1. The first of these, PD 680, Type 1, has a flashpoint value below 100 degrees F, is highly flammable, and will not be used for cleaning operations.

3.1.2.2. The other, PD 680, Type 2, has a flashpoint value of 140 degrees F or higher and is the recommended type of solvent to be used for cleaning operations, because of the higher flashpoint value.

3.1.2.3. There will be no change in cleaning solvent from the PD 680 Type 2 or compound emulsion cleaning solvent (Mil Spec C-25179) without prior approval of the fire chief, ground safety officer, and the BEE. The following items WILL NOT be used: acetone, benzene, carbontetrachloride, gasoline, isopropyl alcohol, methanol, methylethyl, ketone, naphtha (solvent), perchloroethylene, toluene, trichloroethylene, or turpentine. Commercial cleaning solvents, such as "Safety Klean" or other non-flammable emulsion type cleaning liquids should be considered for use where possible.

3.1.3. Flammable cleaning solvents, jet fuel, or aviation gas (AVGAS) will not be used to clean floors, clothing, or parts.

3.1.4. Cleaning rooms will be equipped with an adequate mechanical ventilation system; it shall conform to the standard for blowers and exhaust system (refer to NFPA 91, *Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying*, and AFOSH Standard 48-2).

3.1.5. There shall be no open flames, spark-producing devices, or heated surfaces having a temperature sufficient to ignite vapors in any vapor area.

3.1.5.1. There shall be no electrical equipment in the immediate vicinity of cleaning tanks which are subject to splashing or dripping of cleaning tank liquids.

3.1.5.2. There shall be no open flames or spark-producing devices in any floor space outside a vapor area, or within 20 feet thereof (not separated by tight partitions), except as specifically permitted in NFPA 86A, *Ovens and Furnaces Design, Location, and Equipment*. Areas in the vicinity of dip tanks shall be kept as clear of combustible stock as practical and shall be kept entirely free of combustible debris.

3.1.6. When waste or rags are used in connection with dipping operations, approved metal waste cans with self closing lids shall be provided and all impregnated rags or waste will be placed there immediately after use. The contents of waste cans shall be properly disposed of at least once daily at the end of each shift.

3.1.7. Periodic inspection or test of all dip tank facilities shall be made, including ventilating facilities and all extinguishing equipment. Any defects found shall be promptly corrected.

3.1.8. Approved and effective warning signs stating, "DANGER - NO SMOKING" shall be conspicuously posted in the vicinity of dip tanks.

3.1.9. Areas in the vicinity of dip tanks shall be provided with manual fire extinguishers suitable for combustible liquids. Protection systems shall be provided for tanks 150 gallon capacity and over or 10 square feet in liquid surface area and over (refer to NFPA 34, Chapter 8, *Dipping and Coating Processes Using Flammable or Combustible Liquids*).

3.2. Specific Requirements:

3.2.1. Personal Protective Equipment (PPE):

3.2.1.1. When handling parts cleaned in PD 680 solvent, all personnel will wear rubber gloves and keep the inside of gloves clean and dry. Rubber gloves and an apron will be worn when acids are being poured or dumped. Eye protective devices with side, as well as frontal protection, shall also be worn (refer to AFOSH Standard 91-31 for approved types).

3.2.1.2. Contact lens wearers will wear appropriate eye and face protection (refer to AFOSH Standard 91-31). **NOTE:** Workers should advise supervisors if they wear contact lenses.

3.2.1.3. The BEE should evaluate these operations to determine if respiratory protection is required.

3.2.2. Engine Cleaning. The following precautionary measures will be taken when cleaning installed vehicle engines. The starters, generators, alternators, distributors, or magnetos will be protected (covered with waterproof paper or plastic) so the internal mechanism will not be exposed to water spray or cleaning agents. The air cleaner will be removed and the carburetor throat covered with waterproof paper (or plastic). The procedures established in TO 36-1-5, *Processing of Motor Vehicle for Storage and Shipment*, will be used for cleaning installed engines.

3.2.2.1. Employees involved in cleaning operations are required to wear the PPE listed in paragraph 3.2.1.

3.2.2.2. When cleaning tanks are located in an isolated room or facility, users will obtain permission from the appropriate supervisor to use the tank and the buddy system will be used when required by management and safety to ensure assistance is available in case of a mishap or an emergency.

3.2.3. Solvent Storage and Handling. Bulk solvents should be stored in well-ventilated rooms, physically separated from other storage and operations. Caution and warning labels shall not be removed. Leaking drums will be removed outdoors immediately so vapors or liquid will not gather in pockets where their concentration may become hazardous. Drip pans will not be used to catch spilled liquids unless these pans drain into a closed container. Approved containers with the name of the solvent

clearly painted on the container shall be used. The BEE will help determine the adequacy of the ventilation in areas where solvents are to be used, prior to their use.

Chapter 4

PAINT SHOP

4.1. General Requirements . For safe and efficient operation, it is essential that all painting activities be done according to accepted safety standards.

4.2. Specific Requirements:

4.2.1. Personal Protective Equipment (PPE). The BEE will be consulted to determine if respiratory protection is required and if needed, what type is required.

4.2.2. Housekeeping. Good housekeeping is essential to safe operations in Air Force paint shops. Paint rooms will be kept clean and their equipment stored in an orderly manner.

4.2.3. Spray Booths. Spray booths will be used whenever possible in paint shops to minimize the health, fire, and explosion hazards. The walls of these booths will be made of fire-resistant material that can be easily and frequently cleaned (refer to AFOSH Standard 91-17, *Interior Spray Finishing*, and AFOSH Standard 48-2 for details of construction and installation of ventilating systems for paint-spraying operations).

4.2.3.1. Walls. Walls and floors of spray booths may be covered with paper to protect them from paint deposits. This paper will be removed and destroyed when contaminated. Soap-like water-soluble materials or coatings which can be stripped, or other similar materials that can be easily washed down, may be used to protect the walls and floors of spray booths from paint accumulation as long as they do not pose or create an environmental pollution problem. Protective paper wall coatings will not be used for dry or dusty painting substances that can be removed from the booths by adequate ventilation (refer to NFPA 33, *Spray Application Using Flammable and Combustible Materials*). **NOTE:** Paint facilities with overhead sprinklers should have sprinkler heads covered with a paper bag to prevent the heads from becoming clogged with paint overspray.

4.2.3.2. Direction of Spray. Personnel will always spray paint toward the exhaust portal to minimize the accumulation of harmful mists and vapors in the booth and to minimize any potential health hazards from the airborne contaminants. Spray guns will never be pointed toward other personnel.

4.2.3.3. Hand Work. Adequate exhaust ventilation will be provided in booths when hand spray painting is being accomplished. When forced ventilation is impracticable, such as during minor touchup painting, the BEE will determine the need for and type of respirator to be used. Care should be taken in laying pressure hoses to ensure they don't present a tripping hazard for personnel or that lines are cut by passing vehicles. **CAUTION:** There are a number of paint systems available for service use; however, many require additives containing isocyanates. It is essential that all recommendations and warnings listed on the container label for materials selected be followed. Adequate respiratory protection shall be worn. Such protection should be worn during the entire painting process. Those persons allergic to isocyanate will not be exposed to isocyanate. The BEE will be consulted.

4.2.4. Ventilation. Mechanical ventilation will be provided in all paint spray booths to prevent the accumulation of flammable and injurious vapors in the atmosphere (refer to AFOSH Standard 48-2 and OSHA 29 CFR 1910.107, *Spray Finishing Using Flammable and Combustible Liquids*).

4.2.5. Interlocks. Electrical equipment for electrostatic hand spraying shall be interlocked with the ventilation controls of the spray booth so the equipment cannot be operated unless the ventilation fans are in operation (refer to 29 CFR 1910.107).

Chapter 5

AIR COMPRESSORS

5.1. General Requirements :

- 5.1.1. Only qualified personnel will be allowed to repair or adjust pressure-regulating equipment.
- 5.1.2. All personnel operating air compressors will be familiar with air compressor operating instructions.

5.2. Specific Requirements:

- 5.2.1. All new air tanks and safety valves shall be constructed, installed, and maintained according to the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code, Section VIII*. The ASME code seal is permanently stamped on all tanks meeting this criteria.
- 5.2.2. Air receivers shall be installed so all drains are easily accessible. Air receivers should be supported with sufficient clearance to permit a complete external inspection and to avoid corrosion of external surfaces.
- 5.2.3. A drain pipe and valve shall be installed at the lowest point of the air receiver to provide for the removal of accumulated oil and water. The drain valve on the air receiver shall be opened and the receiver completely drained daily to prevent the accumulation of excessive amounts of liquid in the receiver. Air receivers will be stenciled to reflect this requirement (exclude air receivers with automatic drains).
- 5.2.4. Every air receiver shall be equipped with a pressure indicating gauge (located where it is readily visible) and with one or more spring-loaded safety valves. The total relieving capacity of such valves shall prevent pressure in the receiver from exceeding the maximum allowable working pressure of the receiver by more than 10 percent.
- 5.2.5. No valve of any type shall be placed between the air receiver and its safety valve or valves.
- 5.2.6. All safety valves shall be tested at regular intervals by installation civil engineering to determine whether they are in good operating condition.
- 5.2.7. Installed air pressure line outlets will have the delivered air pressure tagged or marked showing maximum working pressure.
- 5.2.8. Air pressure hoses will not be placed where they will create tripping hazards. All hoses will be checked to make sure they are properly connected to pipe outlets before use. A hose will not be kinked to stop the air flow. The control valve will be used to turn off the air. Temporary water hose type clamps or wire connections will not be used to place or repair broken fittings.
- 5.2.9. When used for approved cleaning, compressed air will be regulated to less than 30 psi. Eye protection will be worn. Compressed air should not be routinely used to blow dry parts since this process will increase the worker's inhalation hazards.
- 5.2.10. Vehicles will not be parked or left running near shop compressors that are being used to supply air for spray painter's fresh air masks.

5.3. Compressed Air . Compressed air is used in many shop operations: spray painting, tire inflation, fuel line cleaning, and others. When handled with care and according to accepted safety standards, compressed air can be used safely. Eye protection will be used at all times when cleaning with compressed air.

- 5.3.1. If a worker has cuts on his or her hands or fingers, he or she will not hold parts (that have been washed in cleaning solvent) if they are using compressed air to blow dry the parts (refer to paragraph 5.2.9.). Personnel will wear neoprene or rubber gloves to avoid problems.
- 5.3.2. A vacuum system or water hose will be used to remove dust, etc., from large surfaces.
- 5.3.3. Compressed air will not be used to clean clothing or the body.
- 5.3.4. Compressed air will not be used to “spin-dry” bearings.

Chapter 6

COMPRESSED GAS CYLINDERS

6.1. General Requirements . In the vehicle maintenance shops, acetylene and oxygen are used in welding, Freon 12 as a refrigerant, and liquid petroleum gas (butane-propane) as a motor vehicle fuel. The cylinders may contain pressures up to 3,600 psi. Cylinders are designed and constructed according to Department of Transportation (DOT) regulations and bear the DOT identification. This stamping is generally found near the neck of the cylinder. Subsequent reinspections will be stamped in the same area. The contents of the cylinder will be legibly marked on each cylinder in large letters (refer to Military Standard (Mil Std) 101B, *Color Code for Pipelines and for Compressed Gas Cylinders*; OSHA 29 CFR 1910.101, *Compressed Gases*; 1910.102, *Acetylene*; 1910.103, *Hydrogen*; 1910.104, *Oxygen*; 1910.105, *Nitrous Oxide*, and applicable TOs.

6.2. Specific Requirements :

6.2.1. Inspection. Cylinders are inspected upon receipt at the installation or organization by a qualified supply inspector for DOT identification, general condition, valve, content labeling, and hydrostatic due date. The user should perform a similar inspection when receiving the cylinder from supply (refer to AFI 23-204, *Organizational Fuel Tanks*).

6.2.2. Manual Handling:

6.2.2.1. Because of their shape and weight, most cylinders are difficult to handle manually. However, if such handling is necessary, they should be tipped slightly and rolled on the bottom edge, not dragged or slid across the floor. Mechanical handling generally requires carts in which cylinders are secured on specially constructed skids. The use of electromagnets or slings is not acceptable for mechanical handling. The insertion of bars through the protective caps may damage the valve assembly; for this reason, bars will not be used. Cylinders will not be handled without protective caps in place.

6.2.2.2. Cylinders will not be dropped or permitted to strike each other. Cylinders will not be used as rollers or for any purpose other than gas containers. Cuts or abrasions and corrosion on cylinders may seriously reduce their design strength and should be brought to the attention of the supply inspector.

6.2.2.3. Acetylene cylinders will never be placed on their sides or laid down for any reason.

6.2.3. Use:

6.2.3.1. Before connecting compressed gas cylinders to a regulator or system outlet, cylinders will be cleared of dust and particles (except cylinders containing hydrogen or toxic gases). The valve will be pointed away from the body and other personnel, then opened slightly to blow out foreign material.

6.2.3.2. A compressed gas cylinder will not be used without a pressure reducing regulator attached to the valve. If cylinders are in a manifold, the regulator will be attached to the manifold header. Only regulators and pressure gauges designed for the specific gas will be used. *Workers will not attempt to force connections that do not fit easily.* If a leak develops between the cylinder and regulator, the gas should be shut off at the bottle before attempting to tighten the union.

6.2.3.3. All compressed gas valves will be opened slowly to prevent sudden surges of pressure that may damage regulators. In the case of oxygen, the valve should be opened fully to gain the benefit of the sealing qualities of the double-seated valve. Valves on acetylene cylinders will never be opened more than a one-quarter turn or exceed 10 psi on the gauge. The special tool recommended by the supplier should be the only tool used for these valves. The tool will be left on the valve. Compressed gas cylinder valves will be closed when not in use.

6.2.3.4. When high and low pressure gas are used on the same cylinder cart, the hoses should be different colors and the fittings on the ends of these hoses different types and sizes.

6.2.3.5. Oil or grease will not be used as a lubricant on oxygen cylinder outlets or its attachments. Oxygen cylinders and attachments will be handled with oil-free hands, gloves, and clothing. Oxygen will never be used as a substitute for compressed air in pneumatic tools.

6.2.4. Manifolds for Compressed Gas Cylinders. They will be a type approved by the gas supplier or other reputable manufacturer for the gas being used. Connections will be tested for tightness by the use of an approved leak testing product or soap and water. **CAUTION:** An open flame will NEVER be used to test for leaks.

6.2.5. Storage:

6.2.5.1. Inside storage areas for cylinders should be free from excessive heat and kept clean. Flammable gases should be stored separately from other gases and oxygen. Storage areas should have good natural ventilation or else mechanical ventilation should be provided. Inside storage areas will be identified with product identification.

6.2.5.2. Cylinders of one type should not be mixed with cylinders of other types. Where a safe distance between flammable gases and oxygen cannot be maintained, partitions of fire resistant material shall be provided. Floors should be level and of noncombustible construction.

6.2.5.3. Outside storage requires all the protection afforded by inside storage, plus a noncombustible canopy to protect cylinders from adverse weather and the sun.

6.2.5.4. All cylinders will be stored upright, with the valve up. Empty cylinders will be stored apart from full cylinders and the word "EMPTY" or "MT" chalked in large letters on them. The valves will be closed and protective caps put in place. Storage areas will be free of sources of ignition and smoking prohibited.

6.2.5.5. The storage area should be provided with chains (or similar devices) to keep the cylinders from being knocked over. Areas near elevators, stairs, or ramps should be avoided for storage, because cylinders could easily be knocked down or damaged. It is desirable to plan storage so cylinders are used in the order in which they are received.

6.2.5.6. In main areas of type "C" (combustible) constructed buildings other than storage buildings, the amount of flammable gas stored will be according to AF 23-series instructions. In main areas of noncombustible constructed buildings, the amount of gas will also be according to applicable AF 23-series instructions. In cutoff rooms and enclosures within buildings of combustible construction or occupancy, the amount of gas will also be limited. (Refer to **Table 6.1.**)

Table 6.1. Cylinder Data for Commonly Used Gases.

Gas	Chemical Symbol	Usual Cylinder Pressure at 70 Degrees F psi	Capacity of Typical Cylinders Cu Ft. Lb.	Calculated Density at 32 degrees F Atmospheric Pressure	Fire Hazard
Acetylene	C ₂ H ₂	250	300 22	0.91	Severe
Air, Compressed	...	1600-3600	200 15	1.0	None
Argon	A	1600-2000	200 21	1.38	None
Butane	C ₄ H ₁₀	19	780 122	1.87	Severe
Carbon dioxide	CO ₂	830	440 50	1.53	None
Bromotrifluoromethane (Freon 1301)	CBrF ₃	200	26 10	4.77	None
Dichlorodifluoromethane (Freon 12)	CCl ₂ F ₂	70	435 145	4.17	None
Helium	He	1600-2000	200 2.2	0.138	None
Hydrogen	H ₂	1600-2000	200 1.0	0.069	Severe
Nitrogen	N ₂	1600-3600	225 16	0.97	None
Oxygen	O ₂	1600-3000	245 20	1.11	Intensifies
Propane	C ₃ H ₈	110	850 100	1.56	Severe

Chapter 7

LIFTING DEVICES

7.1. Inspection . Many lifting device mechanical failure problems can be detected prior to failure if proper inspection procedures are followed. Periodic inspections will be performed by qualified inspectors or maintenance personnel. Tests and certification of cranes and hoists will be by experienced, qualified inspectors. Certification, inspection, and test reports will be available on the premises where the crane or hoist is located or in the supervisor's office.

7.2. Responsibilities . Responsibilities for periodic inspection, records, maintenance, and test of lifting devices and separate lifting aids will be as follows:

7.2.1. Permanently Installed Equipment (Real Property Installed Equipment (RPIE)). Installation civil engineer.

7.2.2. Mobile Equipment. Vehicle maintenance officer and (or) superintendent.

7.2.3. Fixed Shop and Portable Equipment (Equipment Authorized Inventory Data (EAID)). Responsible activity, as described in Air Force Manual (AFMAN) 23-110V2CD, *USAF Supply Manual (FOUO)*.

7.2.4. Hoists and Cranes. Refer to specific technical data. If none is available, consult local installation civil engineering or safety representatives.

7.3. Specific Requirements :

7.3.1. Hydraulic Vehicle Lifts:

7.3.1.1. Workers should stand to one side of the vehicle as it is being driven into position on the lift. The load should be resting squarely on the lift. The operator will close the vehicle doors, hood, and trunk and make sure there is no one inside the vehicle prior to raising it (*except to facilitate repairs*). (This applies to vehicle lifts equipped with automatic locking devices that will not allow the vehicle to descend with loss of power). The operator will know the load limits of the lift and adapter and be certain it is not overloaded. The operator should not lock the hoist controls in the open or shut position, but operate them manually. All vehicle lifts shall be equipped with a safety device to prevent accidental lowering. The device can be a simple mechanism such as a safety leg which locks in a vertical position as the lift is raised, or it can be a restricted orifice device which permits controlled lowering in the event of hydraulic failure. As an added safety feature, air-oil operated hydraulic lifts should be equipped with a lock which prevents raising by air if the oil supply is low. A safety device meeting this requirement is a "low oil lock." This is a removable device which prevents compressed air from entering the lift cylinder assembly; the arrangement prevents the plungers from being raised above the oil supply in the air-oil reservoir.

7.3.1.2. Roll-on lifts should be equipped with stop chocks to prevent the vehicle from moving while the lift is hoisting, lowering, or in the elevated position. Preferably, stop chocks will be automatic — springing into position when the vehicle enters upon the lift.

7.3.1.3. All vehicle lifts should be marked with the name of the manufacturer, lift capacity, and date of installation. These markings should be stamped or etched on a metal plate permanently attached to the lift in a position where it can be inspected.

7.3.1.4. All vehicle lifts should be equipped with “deadman” controls which automatically turn to **NEUTRAL** or **OFF** when released by an operator. Controls should be conveniently located near a lift.

7.3.1.5. A lift will not be used and an appropriate hazard warning tag attached if it:

- 7.3.1.5.1. Jerks or jumps when raised;
- 7.3.1.5.2. Slowly settles down after being raised;
- 7.3.1.5.3. Slowly rises, either when in use or when not in use;
- 7.3.1.5.4. Comes down very slowly;
- 7.3.1.5.5. Blows oil out of the exhaust line; or
- 7.3.1.5.6. Leaks oil at the packing gland.

7.3.2. Electric Vehicle Lifts:

7.3.2.1. Inspect the lift daily. Never operate it if it has damaged parts which render it unsafe. Make repairs with original equipment parts (if possible).

7.3.2.2. Operating controls are designed to close when released. Do not block open or override them.

7.3.2.3. Never overload the lift. The manufacturer’s rated capacity is shown on the nameplate affixed to the lift.

7.3.2.4. Do not operate the lift if any safety devices are inoperative.

7.3.2.5. Allow only trained and authorized personnel to position the vehicle and operate the lift.

7.3.2.6. Never raise the vehicle with anyone inside, *except to facilitate repairs*. (This applies to vehicle lifts equipped with automatic locking devices that will not allow the vehicle to descend with loss of power). Do not allow anyone under the vehicle when raising or lowering the lift. When operating the lift, stand outside of it and keep hands clear of all moving parts.

7.3.2.7. Always keep the lift area free of obstructions, grease, oil, trash, and other debris.

7.3.2.8. Before driving the vehicle over the lift, position arms and supports to provide unobstructed clearance. Do not hit or run over lift arms, adapters, or axle supports. This could damage the lift or the vehicle.

7.3.2.9. Position the vehicle on the lift carefully. Position lift supports to contact at the vehicle manufacturer’s recommended lifting points. Raise lift until supports contact the vehicle. Check supports for secure contact with vehicle. Raise the lift to desired working height. **CAUTION:** Raise the lift high enough for the locking device to be engaged whenever someone is working under the vehicle.

7.3.2.10. Do not attempt to move the vehicle when the lift is off the ground.

7.3.2.11. Note that with some vehicles, the removal (or installation) of components may cause a critical shift in the center of gravity and result in raised vehicle instability. Refer to the vehicle manufacturer’s service manual for recommended procedures when vehicle components are removed.

7.3.2.12. When performing maintenance on electrical lifts, be sure electrical power is disconnected unless required for checking unit operation.

7.3.2.13. Before lowering the lift, be sure tool trays, stands, etc., are removed from under the vehicle and vicinity of the lift. Release locking devices before attempting to lower the lift.

7.3.2.14. Lower the lift slowly.

7.3.2.15. Before removing the vehicle from the lift area, position lift arms and supports to provide an unobstructed exit.

7.3.3. Jacks. Vehicle maintenance personnel will not use hydraulic floor jacks, post jacks, or mechanical jacks to support vehicles while repair is accomplished. The vehicle will be blocked and placed on approved axle or frame stands before a repair operation is started.

7.3.3.1. The rated load of the jack will be legibly and permanently marked in a prominent location by casting, stamping, or other suitable means.

7.3.3.2. Shop personnel will not use a jack which is leaking or one which is faulty in its operation. Defective jacks will be taken out of service immediately, tagged, and not used again until repaired.

7.3.3.3. Shop personnel will exercise care in positioning jacks under vehicles, making sure the cap is located properly to preclude the jack from slipping after the load is applied. A flat piece of wood, thick enough to withstand the load, can be placed between the jack cap and the vehicle lift point to help prevent the jack cap from slipping.

7.3.3.4. All jacks shall be properly lubricated at regular intervals and only lubricants recommended by the manufacturer should be used.

7.3.3.5. Improper jacking can cause serious injury or property damage. The following jacking procedures will be used:

7.3.3.5.1. Equipment will be properly chocked prior to jacking.

7.3.3.5.2. Jack stands will be used any time equipment is jacked for maintenance.

7.3.3.5.3. Equipment will be removed from jacks as soon as possible.

7.3.3.5.4. Equipment will be jacked to the minimum height required for the particular task.

7.3.3.5.5. Personnel will only remain under a jacked unit for the time required to place axle or frame stands for support.

7.3.3.5.6. Personnel will not position any portion of themselves under the tire or wheel of jacked equipment.

7.3.3.5.7. Supervisors are responsible for ensuring jacks and jack stands of sufficient capacity are available and utilized.

7.3.3.5.8. Workers will ensure the placement of the jack will not cause damage to the equipment.

7.3.3.5.9. Jacks and jack stands will be inspected and maintained according to AF technical data. If no technical data exists, manufacturer's manuals may be used as long as it meets the criteria in OSHA 29 CFR 1910, Subpart P, *Hand and Portable Powered Tools and Other Hand-Held Equipment*.

7.3.3.5.10. Defective jack stands will be taken out of service immediately and tagged for disposition.

Chapter 8

TIRE AND WHEEL MAINTENANCE

8.1. Employee Training:

8.1.1. Extensive damage to equipment and serious injury to personnel have resulted from careless or improper demounting, mounting, and inflation of tires on both single piece and multi-piece rim wheels. To ensure the safety of both equipment and personnel, all persons involved in wheel dismantling or buildup operations will be thoroughly familiar with the applicable TOs, rim manuals, OSHA charts entitled "Demounting and Mounting Procedures for Truck and Bus Tires" and "Multi-piece Rim Matching Chart" (refer to **Attachment 2**), and this standard for the particular wheel involved. The precautions outlined in these publications will be strictly adhered to when working on wheels and rims. As an added safety measure, procedures will be reviewed prior to starting tire maintenance operations.

8.1.2. The supervisor shall provide a program to train and instruct all workers who service multi-piece or single piece rim wheels, in the proper techniques and practices applicable to the type of wheel being serviced. A mechanic's level of proficiency will be established by demonstration of his or her familiarity with and ability to use the information contained in the charts, rim manuals, TOs, and this standard. Refer to **Attachment 3** for procedures relating to tubeless passenger car tires.

8.1.3. The supervisor shall ensure each worker demonstrates and maintains the ability to service rim wheels safely, including performance of the following tasks:

8.1.3.1. Inspection of the rim wheel components;

8.1.3.2. Mounting of tires (including inflation within a restraining device or other safeguard required by this chapter) (refer to **Attachment 4** and **Attachment 5**);

8.1.3.3. Use of the restraining device, barrier, and other equipment required by this chapter;

8.1.3.4. Handling of rim wheels;

8.1.3.5. Inflation of the tire when a rim wheel is mounted on the vehicle;

8.1.3.6. An understanding of the necessity of standing outside the trajectory (refer to **Attachment 4** and **Attachment 6** for further trajectory information) both during inflation of the tire and during inspection of the tire following inflation; and,

8.1.3.7. Installation and removal of rim wheels.

8.1.4. The supervisor shall evaluate each worker's ability to perform these tasks and to service rim wheels safely and shall provide additional training as necessary to ensure each worker maintains proficiency.

8.2. Tire Servicing Equipment:

8.2.1. The supervisor shall ensure a restraining device for servicing multi-piece rim wheels is available and used.

8.2.2. When servicing single piece rim wheels, the worker shall provide a restraining device or a barrier, except where the rim wheel is bolted to the vehicle during inflation.

8.2.3. Supervisors shall ensure restraining devices and barriers meet the following requirements:

8.2.3.1. Each restraining device or barrier shall have the capacity to withstand the maximum force that would be transferred to it during an explosive rim wheel separation occurring at 150 percent of maximum tire specification pressure for the type wheel being serviced.

8.2.3.2. Restraining devices and barriers shall be capable of preventing the rim wheel components from being thrown outside or beyond the device or barrier for any rim wheel positioned within the device.

8.2.3.3. A restraining device or barrier shall not contain a solid flat surface against which the rim wheel can lie or lean during inflation, such as the bed or table of a tire changing machine.

8.2.3.4. Restraining devices and barriers shall be visually inspected prior to each day's use and after any explosion or explosive separation of the rim wheel components. Any restraining device or barrier exhibiting damage such as the following defects shall be immediately removed from service:

8.2.3.4.1. Cracks at welds;

8.2.3.4.2. Cracked or broken components;

8.2.3.4.3. Bent or sprung components caused by mishandling, abuse, tire explosion, or rim wheel separation;

8.2.3.4.4. Pitting of components due to excessive corrosion;

8.2.3.4.5. Other structural damage;

8.2.3.4.6. Inoperative air pressure warning light or gauge.

8.2.4. The supervisor shall ensure a hose assembly consisting of the following components is used for inflating rim wheels.

8.2.4.1. A clip-on chuck;

8.2.4.2. A sufficient length of hose to allow the employee to stand outside the trajectory; and

8.2.4.3. An in-line valve with a pressure gauge or an adjustable regulator.

8.2.5. Tire inflator cage (NSN 4910-00-025-0623, Part Number [P/N] 64E33077) is authorized and will be used for inflating multi-piece wheels. A regulator gauge, shutoff valve, service hose, and lock-on type chuck will be used with the cage to control the air when inflating. Also, a bleed valve will be used to relieve the pressure in the hose when the tire is filled (refer to TO 00-25-246, *Selection, Inspection, Service, and Control of Motor Vehicle Tires*, and **Attachment 5** of this standard).

8.2.6. Current OSHA tire charts shall be available and posted in the service area (refer to **Attachment 2**).

8.2.7. A current rim manual and TO 00-25-246, containing instructions for the types of wheels being serviced, shall be available in the service area (refer to **Attachment 2** for further information on the referenced rim manual).

8.2.8. The supervisor shall ensure that only tools recommended in the rim manual for the type of wheel being serviced are used to service rim wheels. **WARNING:** Failure to observe the precautions

outlined in this standard may result in faulty positioning of the tire and (or) rim parts, causing the assembly to burst with explosive force sufficient to cause serious physical injury or death.

8.3. Wheel Component Acceptability:

8.3.1. Multi-piece wheel components shall not be interchanged except as provided in the charts or in the applicable rim manual.

8.3.2. Multi-piece wheel components and single piece wheels shall be inspected prior to assembly. Any part of a wheel which is bent out of shape, pitted from corrosion, broken, or cracked shall not be used and shall be rendered unserviceable and discarded. Damaged or leaky valves shall be replaced.

8.3.3. Rim flanges, rim gutters, rings, bead seating surfaces, and the bead areas of tires shall be free of any dirt, surface rust, scale, or loose or flaked rubber build-up prior to mounting and inflation.

8.3.4. The size and type of both the tire and the wheel shall be checked for compatibility prior to assembly of the rim wheel.

8.4. Safe Operating Procedure — Multi-piece Rim Wheels . The supervisor shall establish a safe operating procedure for servicing multi-piece rim wheels and shall ensure workers are instructed in and follow that procedure. The procedure shall include at least the following elements:

8.4.1. Tires shall be completely deflated by removing the valve core, before a rim wheel is removed from the axle. Workers should use mechanical devices, such as dollies, to help them remove or mount large, heavy tires.

8.4.2. Rubber lubricant shall be applied to bead and rim mating surfaces during assembly of the rim wheel and inflation of the tire, unless the wheel or tire manufacturer advises against its use. The rubber lubricants used will not be flammable.

8.4.3. Tires mounted on multi-piece rims (after service) will only be inflated when constrained by a restraining device or placed in a tire cage (refer to **Attachment 5**). Tires on multi-piece rims (mounted on vehicles) that are determined to be more than 20 percent underinflated should not be reinflated until an inspection by a qualified person has been performed and the tire certified safe to reinflate. Chains may be used to encase the wheel and tire during the reinflation process, along with the remote control inflation equipment. Supervisors will ensure that no personnel are in the trajectory area during tire reinflation. No heat shall be applied to a multi-piece rim with a tire mounted on it. **Exception:** After the tire is completely deflated, the lug nuts may be heated briefly to facilitate their removal.

8.5. Safe Operating Procedure — Single Piece Rim Wheels . The supervisor shall establish a safe operating procedure for servicing single piece rim wheels and shall ensure employees are instructed in and follow that procedure. The procedure shall include at least the following elements:

8.5.1. Tires shall be completely deflated by removal of the valve core before demounting. Mechanical devices, such as dollies, will be used to mount or remove large, heavy tires.

8.5.2. Mounting and demounting of the tire shall be done only from the narrow ledge side of the wheel. Care shall be taken to avoid damage to tire beads while mounting tires on wheels. Tires shall be mounted only on compatible wheels of matching bead diameter.

8.5.3. Rubber lubricant shall be applied to bead and wheel mating surfaces before assembly of the rim wheel and inflation of the tire. The rubber lubricant used will not be flammable.

8.5.4. If a bead expander is used to seat the beads, it shall be removed before the valve core is installed and before the tire is inflated to more than 10 pounds per square inch, gauge (psig).

8.5.5. Tires may be inflated above 10 psig only when contained within a restraining device, positioned behind a barrier, or bolted on the vehicle with the lug nuts fully tightened. The tire pressure will never be serviced above the tire pressure stamped on the sidewall, unless the manufacturer recommends a higher pressure.

8.5.6. Workers shall not place a rim wheel so that any flat solid surface is in the trajectory and within one foot of the sidewall. **Exception:** When a restraining device is used, holddown components of the restraining device may be placed within 1 foot of the sidewall. (Refer to paragraph **1.1.10.**)

8.5.7. Tires shall not be inflated to more than their recommended operating pressure. The pressure for the size and type tire and load as specified in the Dash-1 TO will be used. If this information is not available, TO 00-25-246 or the Tire and Rim Association Handbook will be used to obtain the recommended tire pressure.

8.5.8. Workers shall stay out of the trajectory when inflating a tire (refer to **Attachment 4** and **Attachment 6**).

8.5.9. If the tire beads are not fully seated by the time the tire is inflated to its recommended pressure, the tire shall be deflated and the rim wheel disassembled. The wheel and tire shall be rechecked for compatibility, relubricated, repositioned, and then reinflated according to paragraphs **8.5.2.** through **8.5.7.**

8.5.10. No heat shall be applied to a single piece wheel when a tire is mounted on it. **Exception:** After the tire is completely deflated, the lug nuts may be briefly heated to facilitate their removal.

8.5.11. Cracked, broken, bent, or otherwise damaged wheels shall not be reworked, welded, brazed, or otherwise heated, except as provided in paragraph **8.5.10.**

8.5.12. High pressure air will not be used to inflate tires.

8.5.13. Rims will be inspected and maintained according to the individual equipment manufacturer's rim manuals or TO 00-25-246. **NOTE:** See **Attachment 2** for additional information.

8.6. Do's and Don'ts When Demounting, Mounting, and Inflating All Types of Tires. The following precautions will be followed:

8.6.1. **DO** respect the potential power and explosive force of air under pressure. Serious mishaps have resulted from lack of awareness of the explosive potential of compressed air. Respect it as you would DYNAMITE!

8.6.2. **DON'T** work on tire and rim assemblies until you have reviewed safety practices and procedures.

8.6.3. **DO** make sure all tools are in good condition for use — not damaged, dented, or deformed.

8.6.4. **DO** remove valve core and exhaust all air from the tire (or tires, in the case of a dual assembly), before demounting. Probe the valve stem with a wire as a final check to ensure the valve is not plugged. Do not stand in front of valve opening, as dirt particles may be blown into eyes.

- 8.6.5. **DON'T** loosen lug nuts on duals until all air is exhausted from both tires. A broken or cracked rim part under pressure could blow apart and seriously injure or kill if lugs are removed before air is exhausted.
- 8.6.6. **DON'T** ever apply heat or do repair work on an inflated tire, rim, and wheel assembly. Heat can increase air pressure to a level sufficient to burst the tire or rim.
- 8.6.7. **DO** block vehicle in a positive manner so it cannot roll forward or backward after it is jacked up.
- 8.6.8. **DO** place large hardwood blocks under the jack, regardless of how hard or firm the ground appears.
- 8.6.9. **DO** place safety jacks — or crib up with blocks — at an appropriate spot under the vehicle, in case the jack slips.
- 8.6.10. **DON'T** reinflate a tire that has been run flat or seriously underinflated without demounting that tire and checking the tire and tube for damage.
- 8.6.11. **DO** check rim diameter to ensure it exactly matches rim diameter molded on tire.
- 8.6.12. **DO** clean and inspect used rim parts thoroughly.
- 8.6.13. **DON'T** mix rim parts of different manufacturers unless such use is approved by those manufacturers.
- 8.6.14. **DON'T** attempt, under any circumstances, to rework, weld, heat, or braze rim parts. Replace damaged parts with same size, type, and make.
- 8.6.15. **DO** use new tubes and new flaps in new tires.
- 8.6.16. **DON'T** reuse tubes or flaps that have buckled or creased.
- 8.6.17. **DON'T** use a tube in a tire larger or smaller than that for which the tube was designed.
- 8.6.18. **DO** inspect inside of tire for loose cords, cuts, penetrating objects, or other carcass damage. Scrap tires that are damaged beyond simple repair. Remove dirt, debris, and liquids from inside of tire before tube is installed.
- 8.6.19. **DO** lubricate with approved rubber lubricant, such as thin vegetable oil or soap solution.
- 8.6.20. **DO** use a clip-on chuck and extension hose with remote control valve and pressure gauge, long enough to allow you to stand to one side — not in front of the assembly — during inflation.
- 8.6.21. **DO** center tire properly on rim before inflating.
- 8.6.22. **DO** securely lock wheel down, or place assembly in safety cage or portable safety device, before attempting to inflate tire to seat beads.
- 8.6.23. **DO** position the vehicle crane boom in the center of the hub prior to inflation of off-the-road tires in field service work.
- 8.6.24. **DON'T** inflate beyond recommended bead seating pressure.
- 8.6.25. **DON'T** stand over tire when inflating.
- 8.6.26. **DO** check for proper flange and lock ring seating.

8.6.27. **DO** adjust air pressure to manufacturer's recommended cold operating pressure, after beads have been seated.

8.6.28. **DO** inspect valve cores for proper air retention. Replace damaged or leaky cores.

Chapter 9

MAINTENANCE OPERATIONS

9.1. General Requirements :

9.1.1. Only authorized shop personnel will be allowed on the shop floor. All other persons will remain in designated areas so they don't interfere with shop operations. Drivers will not approach mechanics on the floor to report discrepancies. At times when an operator is needed to further define a vehicle problem, shop supervision will authorize that person's presence on the floor. Normal operator debriefing will be the function of the Diagnostic and Quality Assurance Section.

9.1.2. Vehicle operators and mechanics will sound vehicle horns before backing and intermittently during the entire backing operation unless vehicles are equipped with backup alarms. They will stop and sound horn prior to entering and leaving the maintenance shop. When moving large equipment and vehicles backwards, if vision of the operation is obstructed or obscured, a spotter will be posted. The spotter will be visible to the operator and will not stand directly behind the vehicle. Roll-down or side sliding doors will be completely opened whenever a vehicle enters or exits the vehicle maintenance shop.

9.1.3. Door frames of doorways used by vehicle for entry and exit, lower portion of garage or roll-down doors, and any obstruction (building support columns, etc.) within the vehicle maintenance area that could pose a hazard to vehicular traffic, will be highlighted. The highlighting will be angled black and yellow stripes at least 4-feet high.

9.1.4. The potential for catching, snagging, and pulling of rings and jewelry exists in and around vehicle maintenance operations. Because of this, controls shall be exercised over the wearing of rings, watches, bracelets, necklaces, and other items of jewelry. All such items of jewelry shall be removed before working on or around shop equipment or vehicles.

9.1.5. Vehicle maintenance personnel will not wear neckties, loose flowing garments, loose sleeves, or gloves which can become entangled when working on or around shop equipment or vehicles. Open footwear and canvas or cloth shoes shall not be worn in the maintenance shops. AFOSH Standard 91-31 will be consulted for PPE to be worn by personnel with long hair.

9.1.6. Compressed air will not be used to clean dirt and dust from clothing or the body. When used for approved cleaning, compressed air will be regulated to less than 30 psi. Eye protection will be worn.

9.1.7. Mechanics will NEVER place any part of their body directly under the wheels or tires of a jacked up vehicle without jack stands.

9.1.8. Axle stands with a minimum of 10-ton rating will be used for axle support on refuelers.

9.1.9. Hydraulic jacks with a rating of no less than 10 tons shall be used when lifting refueling vehicles.

9.1.10. Only one wheel per axle or one dual wheel assembly shall be jacked at one time.

9.1.11. AFOSH Standard 91-31 will be consulted for the proper PPE to be worn.

9.1.12. No person outside the range of prompt and easy communication with other employees shall perform work that presents a risk of serious injury unless a second person is available to alleviate or mitigate an emergency.

9.1.13. No employee will enter a confined space until the atmosphere has been evaluated by the supervisor and is either found to be safe to enter or proper precautions, approved by the BEE, are taken. AFOSH Standard 91-25, *Confined Spaces*, will be consulted for guidance and procedures.

9.1.14. Workers will never use ramps on soft earth. They will ensure the ramps rest on a firm, level surface.

9.2. Specific Requirements :

9.2.1. Body Shops:

9.2.1.1. The jagged edges of mangled fenders, decks, and quarter panels can be razor sharp. Protective gloves will be worn when handling them.

9.2.1.2. A full protective plastic face shield plus safety glasses or goggles will be worn while cutting or grinding glass. If handling large sheets of glass, gloves will be used for a better grip and to keep hands from being cut.

9.2.2. Welding. Selected information applicable to vehicle maintenance shops is given below. AFOSH Standard 91-5 will be consulted for more detailed guidance on welding.

9.2.2.1. General Precautions:

9.2.2.1.1. Inspect all equipment regularly. Equipment will not be used with worn, leaky, or burned gas hoses or damaged cables and connections.

9.2.2.1.2. Never weld or cut *any* new or used gas tanks, oil barrels, or drums without first purging and inerting them.

9.2.2.1.3. Weld behind flame resistant screens or in booths to protect other workers from flying sparks and flash burns.

9.2.2.1.4. Always provide adequate ventilation. Arrange work so the moving air pulls fumes away from the breathing zone.

9.2.2.1.5. Wear clean, oil free, flame resistant clothing while welding. Wear protective gloves and apron (hearing protection may be required for some welding operations).

9.2.2.1.6. Wear special welder's goggles as specified in AFOSH Standards 91-5 and 91-31 (a welding helmet may also be required).

9.2.2.1.7. Provide a suitable fire extinguisher and pails of sand in the vicinity of the welding area. Mount fire extinguishers (if space permits) on portable welding carts that are used in locations where adequate fire extinguishers are not available.

9.2.2.1.8. Always mark hotwork either with a sign or with chalk on the work itself.

9.2.2.1.9. Store welding equipment securely when not in use.

9.2.2.1.10. Have welding tasks evaluated by the BEE to determine the need for (and type) of respirator. Respiratory protection may be required.

9.2.2.2. Gas Welding:

9.2.2.2.1. Store cylinders in areas that are isolated, protected, ventilated, dry, and removed from any heat source.

9.2.2.2.2. Store oxygen cylinders and welding gas cylinders at least 20 feet apart or separate them with a flame resistant barrier at least 5-feet high when not connected for use.

9.2.2.2.3. Keep oxygen cylinders at least 35 feet away from oil, oil pits, and grease.

9.2.2.2.4. Keep cylinder valve caps in place when cylinder is not connected for use.

9.2.2.2.5. Shut cylinder valves off tightly when not in use.

9.2.2.2.6. Do not use acetylene with the tank pressure less than 15 psig.

9.2.2.2.7. Always leave the shutoff wrench on the stem of the valve.

9.2.2.2.8. Secure all tanks with a chain or fire resistant strap.

9.2.2.2.9. Identify cylinders, close the valves, and replace valve caps securely.

9.2.2.3. Electric Arc Welding:

9.2.2.3.1. Carefully spread out cables while performing this work. Avoid walkway areas, thereby preventing tripping hazards.

9.2.2.3.2. Join ground and electrode cables with special connectors.

9.2.2.3.3. Do not allow splices in the cable within 10 feet of the electrode holder.

9.2.2.3.4. To avoid electrical shock, check all connections, ground the workpiece, do not weld in wet locations, and do not use wet machines until they are dry and tested.

9.2.2.3.5. Store electrode holders in a safe location away from objects which conduct electricity.

9.2.3. Mobile Maintenance. Vehicles used routinely for mobile maintenance should include as part of their equipment: baking soda for neutralizing acid spills, adequate fire extinguishers, container of water, and eye and (or) face protection for use by individual performing the jump start procedures.

9.2.4. Air Conditioning Maintenance. Gas and liquid coolants used in automotive air conditioners will be handled with care, especially those stored under pressure. Eye and face protection and gloves will always be worn while servicing or purging these systems.

9.2.5. Radiator Maintenance:

9.2.5.1. Never open a pressurized radiator while the engine is hot. Use eye protection and be careful when boiling out radiator tanks. The cleaning solutions contain caustic chemicals that will burn if splashed on the skin or face. Flush the skin with water if splashed.

9.2.5.2. Wear protective gloves and handle a damaged radiator carefully because it may be a mass of jagged metal.

9.2.6. Fuel Tank Repairs:

9.2.6.1. If the tank is leaking and is still mounted in the vehicle, remove the vehicle from the shop immediately. Attach and ground the siphon tank and pump out the remaining gasoline into a safety can.

9.2.6.2. If the tank requires welding, cutting, or soldering, clean out all fuel and fuel vapors. The best way to do this is by steam cleaning. Steam the tank (both inside and outside) for at least 10 minutes. Flush out the tank with hot water for 5 minutes. Then dry the inside and outside thor-

oroughly, using warm air. After cleaning, check for the odor of fuel and, if needed, repeat the cleaning process. Test the tank for vapors prior to any welding. Refer to TO 34W4-1-5, *Operator MNL—Welding Theory and Application*, for additional information.

9.2.7. Refueler Vehicle Maintenance Areas:

9.2.7.1. Open flames and spark-producing devices are prohibited within 25 feet of the refueling maintenance shop when a refueling vehicle is undergoing maintenance and fuel vapors are likely to be present. There shall be no smoking within 50 feet of a refueler maintenance building. Danger signs will be posted in the immediate area, worded as follows: “No Open Flame or Ignition Source Beyond This Point” or the nearest commercially available equivalent (refer to AFOSH Standard 91-38, *Hydrocarbon Fuels General*).

9.2.7.2. The Base Fuels Management Officer (FMO) will be advised by the installation weather officer of adverse weather with thunderstorms, lightning, strong winds, heavy rain, and freezing precipitation. All maintenance being conducted on fuel systems of fuel servicing vehicles will cease if work is being conducted outside. The weather officer will advise the Fuels Control Center (FCC) when the adverse weather advisory is terminated.

9.2.7.3. Personnel should ground themselves prior to entering a refueler maintenance shop as an extra precaution. There are several methods that can be used to discharge static electricity from the body. If the facility or building is metal, it should be grounded and bonded. Personnel can ground themselves by touching their hand to the bare metal. By touching their bare hand to the door knob they are grounded (if the door is metal and sufficiently bonded to the metal structure).

9.2.7.4. The NEC and NFPA codes provide guidance and (or) requirements for electrical equipment and wiring for all voltages in locations where fire or explosion hazards may exist due to flammable gases or vapors and flammable liquids. The classification used for flammable gases, vapors, and liquids is Class I, Division 1 or 2, Group D. The classification is used to design facilities and buildings. The Division 1 location is in areas below floor level (a pit or depression) and the Division 2 location is in an area up to a level of 18 inches above the floor (NEC articles 511 and 513). This classification does not mean the building is a hazardous location or the working environment is a hazardous area at all times. Certain areas in the building may become hazardous when maintenance is performed on the fuel system, fuel leaks exist, or excessive vapors exist due to venting. If the working environment has flammable vapors greater than 20 percent of the lower explosive limit (LEL), the operation should be shut down and the vapors removed to maintain a safe working environment.

9.2.7.5. Six-inch lengths of bonding straps will be placed at three different locations on all refuelers and will be securely attached to provide suitable ground to the refueler:

9.2.7.5.1. On or near pumping control panel,

9.2.7.5.2. On top of tank near rear ladder; and

9.2.7.5.3. On or near bottom loading control panel.

9.2.7.6. Whenever major maintenance is required to the main tank, all fuel and fuel vapors will be cleaned out from the tank pumping system and filter separator and the tanks purged prior to performing any maintenance. Cleaning procedures outlined in TO 36Y31-1-1, *Removal of Rust and Sediment from Fuel and Oil Servicing Truck and Trailer Tanks and Application of Coating, Inte-*

rior, *Fuel and Water Resistant*, will be complied with. Precautions outlined in the applicable TO of the equipment being serviced will be exercised.

9.2.7.7. When fuel filter elements are changed on refuelers, old filters shall be disposed of according to installation regulations.

9.2.7.8. A minimum of two persons, one qualified in the task to be performed and the other a safety observer, will be available in the refueling maintenance site to provide assistance if needed whenever vehicle repairs are being done on the fuel system. If minor maintenance is needed after duty hours (if all safety precautions are taken and if a qualified 5-skill level mechanic does the work) the Vehicle Maintenance Officer (VMO) may waive the two-person policy in writing. **NOTE:** A vehicle operator for the type of equipment being repaired will qualify as the second person (refer to AFI 24-302, *Vehicle Maintenance Management*).

9.2.7.9. Refueling maintenance personnel performing maintenance on fuel trucks shall not wear shoes with exposed nails or metal plates. Clothing containing 100 percent nylon, rayon, wool, or polyester shall not be worn as outer garments. Outer garments will not be removed or put on in the work area. Matches or lighters will not be handled or removed from pockets.

9.2.7.10. All tools used in the refueling maintenance shop shall be approved for use.

9.2.8. Refueler Maintenance Buildings:

9.2.8.1. Fuel servicing vehicles will not be serviced or repaired in maintenance shops with other vehicular equipment. Because of the number of fueling vehicles and fueling carts normally assigned to an AF installation, a separately sited maintenance and repair facility shall be physically separated from other inhabited structures and any other source of ignition by at least 50 feet. Due to the low number of fueling vehicles and carts normally assigned to an Air National Guard on a constricted area of leased property, a separately sited maintenance and repair facility, separated from other inhabited structures and any other source of ignition by at least 50 feet, is recommended. An empty refueling vehicle containing fuel vapors is a potential bomb and should be treated as such (refer to AFI 24-302 and AFI 32-1024, *Standard Facility Requirements*).

9.2.8.2. The refueling maintenance shop should be located near the refueling vehicle parking area. This minimizes travel distance when bringing refuelers to the shop and also helps keep the refueler off the installation streets.

9.2.8.3. The shop should be located so the fire department will have immediate and direct access on paved roads. One or two minutes saved in fire department response time may mean the difference between saving or losing the facility.

9.2.8.4. Both external and internal earth grounds should be provided for the refuelers and a lightning protection system provided for the structure.

9.2.8.5. Separate locker areas, washing areas, and eating areas should be provided for the workers and PPE adequate for exposure to JP-4 liquid and vapors should be provided (refer to AFIs 24-302 and 32-1024).

9.2.8.6. The amount of square feet required in refueler maintenance areas is determined by the number of refueling vehicles assigned (refer to AFI 32-1024).

9.2.8.7. Floor drains will be kept clean at all times. Solvent or fuel will not be used to clean floor drains. Floor drain contamination is a potential health, fire, and safety mishap potential. Protective clothing such as goggles, rubber boots, and gloves will be worn during drain cleaning.

9.2.9. Vehicle Maintenance Repair Pits:

9.2.9.1. The type of guard used is dependent on the location, reason for the opening, and frequency of use. Where railings are used, they will be permanently attached leaving only one exposed side. The exposed side will have removable railing in place when not in use. It should be painted optic yellow to designate caution.

9.2.9.2. A vertical barrier (toeboard) will be placed at the floor level, along open edges (except at the entrance) of the pit, to prevent materials, tools, etc., from dropping and striking the workers.

9.2.9.3. All pits equipped with steps will have handrails and approved lighting to permit safe operations. Steps should be painted (coated) with an approved nonskid compound to prevent foot slippage.

9.2.9.4. Adequate permanently installed explosion-proof luminaries will be installed in pits or portable explosion-proof extension lights furnished.

9.2.9.5. Pits should be built with drains equipped with oil or grease traps. Pit drains should not be connected to sanitary sewers. In addition, local exhaust should be provided to remove vapors. The BEE will be contacted for ventilation assistance. Exhaust fans used in pits should have explosion-proof motors and non-sparking blades.

9.2.9.6. Pits will be cleaned regularly with soap and water or an approved caustic solution, but not solvents. Pit contamination is a potential health, fire, and mishap hazard. In order to prevent accumulation of hazardous gases, an engine should not be operated while a vehicle stands over a repair pit. PPE (including goggles, rubber boots, and gloves) will be worn during pit cleaning.

FRANCIS C. GIDEON, JR., Maj General, USAF
Chief of Safety

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

Air Force 23-series Supply instructions.

Air Force Instruction (AFI) 23-204, *Organizational Fuel Tanks*.

AFI 24-302, *Vehicle Maintenance Management*.

AFI 32-1024, *Standard Facility Requirements*.

AFI 32-2001, *The Fire Protection Operations and Fire Prevention Program*.

AFI 32-7080, *Pollution Prevention Program*.

AFI 91-301, *Air Force Occupational and Environmental Safety, Fire Protection, and Health (AFOSH) Program*.

Air Force Manual (AFMAN) 23-110V2CD, *USAF Supply Manual (FOUO)*.

Air Force Occupational Safety and Health (AFOSH) Standard 48-1, *Respiratory Protection Program*.

AFOSH Standard 48-2, *Industrial Ventilation* (formerly designated as AFOSH Standard 161-2).

AFOSH Standard 48-8, *Controlling Exposures To Hazardous Materials*.

AFOSH Standard 48-19, *Hazardous Noise Program*.

AFOSH Standard 91-5, *Welding, Cutting, and Brazing*.

AFOSH Standard 91-12, *Machinery* (formerly designated as AFOSH Standard 127-12).

AFOSH Standard 91-17, *Interior Spray Finishing* (formerly designated as AFOSH Standard 127-17).

AFOSH Standard 91-25, *Confined Spaces*.

AFOSH Standard 91-31, *Personal Protective Equipment*.

AFOSH Standard 91-32, *Emergency Shower and Eyewash Units* (formerly designated as AFOSH Standard 127-32).

AFOSH Standard 91-38, *Hydrocarbon Fuels, General*.

AFOSH Standard 91-43, *Flammable and Combustible Liquid* (formerly designated as AFOSH Standard 127-43).

AFOSH Standard 91-56, *Fire Protection* (formerly designated as AFOSH Standard 127-56).

Military Standard (Mil Std) 101B, *Color Code for Pipelines and for Compressed Gas Cylinders*.

National Fire Protection Association (NFPA) 33, *Spray Application Using Flammable and Combustible Materials*.

NFPA 34, Chapter 8, *Dipping and Coating Processes Using Flammable or Combustible Liquids*.

NFPA 70, *National Electrical Code (NEC)*.

NFPA 80, *Standard for Fire Doors and Windows*.

NFPA 86A, *Ovens and Furnaces Design, Location, and Equipment*.

NFPA 91, *Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying*.

NFPA 101, *Code for Safety to Life from Fire in Buildings and Structures Abbreviations*.

National Electrical Code (NEC) Article 511, *Commercial Garages, Repair, and Storage*.

NEC Article 513, *Aircraft Hangars*.

NEC Article 480, *Storage Batteries*.

NEC Article 500, *Hazardous (Classified) Locations*.

Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910 Subpart O, *Machinery and Machine Guarding*.

OSHA 29 CFR 1910, Subpart P, *Hand and Portable Powered Tools and Other Hand-Held Equipment*.

OSHA 29 CFR 1910.37, *Means of Egress, General*.

OSHA 29 CFR 1910.101, *Compressed Gases*.

OSHA 29 CFR 1910.102, *Acetylene*.

OSHA 29 CFR 1910.103, *Hydrogen*.

OSHA 29 CFR 1910.104, *Oxygen*.

OSHA 29 CFR 1910.105, *Nitrous Oxide*.

OSHA 29 CFR 1910.106, *Flammable and Combustible Liquids*.

OSHA 29 CFR 1910.107, *Spray Finishing Using Flammable and Combustible Liquids*.

OSHA 29 CFR 1910.178, *Powered Industrial Trucks*.

OSHA 29 CFR 1910.243, *Guarding of Portable Powered Tools*.

OSHA 29 CFR 1910.304, *Wiring Design and Protection*.

OSHA 3067, *Concepts and Techniques of Machine Safeguarding*.

OSHA Chart, *Demounting and Mounting Procedures for Truck and Bus Tires*.

OSHA Chart, *Multi-piece Rim Matching Chart*.

Tire and Rim Association, Inc., *Rim Manual*.

TO 00-25-246, *Selection, Inspection, Service, and Control of Motor Vehicle Tires*.

TO 32-1-2, *Use of Hand Tools*.

TO 34W4-1-5, *Operator MNL—Welding Theory and Application*.

TO 36-1-5, *Processing of Motor Vehicle for Storage and Shipment*.

TO 36Y31-1-1, *Removal of Rust and Sediment from Fuel and Oil Servicing Truck and Trailer Tanks and Application of Coating, Interior, Fuel and Water Resistant*.

TO 37A-1-101, *General Instruction-Fuel, Water, and Lubricant Dispensing Equipment*.

Abbreviations and Acronyms

AC—Alternating Current
AFI—Air Force Instruction
AFMAN—Air Force Manual
AFOSH—Air Force Occupational Safety and Health
AFSC—Air Force Safety Center
ASME—American Society of Mechanical Engineers
AVGAS—Aviation Gas
BE—Bioenvironmental Engineering
BEE—Bioenvironmental Engineer
C—Celsius
CFR—Code of Federal Regulations
CO—Carbon Monoxide
DOT—Department of Transportation
DRU—Direct Reporting Unit
EAID—Equipment Authorized Inventory Data
F—Fahrenheit
FCC—Fuels Control Center
FMO—Fuels Management Officer
FOA—Field Operating Agency
FOUO—For Official Use Only
GSA—General Services Administration
HEPA—High-Efficiency Particulate Air
LEL—Lower Explosive Limit
MAJCOM—Major Command
Mil Spec—Military Specification
Mil Std—Military Standard
NEC—National Electrical Code
NFPA—National Fire Protection Association
Nicad—Nickel-cadmium
NSN—National Stock Number
OSHA—Occupational Safety and Health Administration

PD—Petroleum Distillate
PDO—Publishing Distribution Office
PEL—Permissible Exposure Limits
P/N—Part Number
PPE—Personal Protective Equipment
psi—Pounds Per Square Inch
psig—Pounds Per Square Inch, Gauge
RPIE—Real Property Installed Equipment
SE—Support Equipment
TA—Table of Allowance
TEL—Tetraethyl
TO—Technical Order
VMO—Vehicle Maintenance Officer
USAF—United States Air Force
WWW—World-Wide Web

Terms

Approved—Listed and approved by the Air Force, DOT, OSHA, the National Fire Protection Association (NFPA), or other nationally recognized agencies which list, approve, test, or develop specifications for equipment to meet fire, health, or safety requirements.

Bonding—The process of connecting two or more metallic objects together by means of a conductor. Bonding is done to equalize electrostatic potential between two or more conductive objects.

Combustible Liquid—A liquid having a flashpoint at or about 100 degrees F (37.8 degrees Celsius (C)).

Demounting—To remove from a mounting, setting, etc. To take apart.

Explosion-Proof—Materials properly enclosed, capable of withstanding a violent expansion or bursting without causing damage to personnel or property or igniting flammable vapors.

Flammable Liquid—A liquid with a flashpoint below 100 degrees F (37.8 degrees C).

Flashpoint—The lowest temperature at which vapors arising from fuel will ignite (momentarily flash) on application of a flame or spark.

Grounded—Connected to earth or to some conducting body that serves in place of earth.

Grounding—The process of connecting one or more metallic objects and ground conductors to ground electrodes.

Hand Tool—Any portable powered or nonpowered tool used for the assembly, disassembly, inspection, servicing, repair, and maintenance of vehicles or equipment.

Hazardous Location—

(1) An area deemed hazardous because of atmospheric concentrations of flammable liquids, gases, or vapors and because deposits or accumulations of materials may be readily ignitable.

(2) An area in which breakdown or faulty operation of equipment or processes will release ignitable concentrations of flammable gases or vapors.

Hazardous Noise Area—Any work area where the combination of sound pressure level and duration of daily exposure is more than the values of tables 2.4 through 2.7 in AFOSH Standard 48-19, *Hazardous Noise Program*.

May—Indicates an acceptable or satisfactory method of accomplishment.

Multi-piece Wheel or Multi-piece Rim—A vehicle wheel or rim consisting of two or more parts, one of which is a side or locking ring designed to hold the tire on the wheel.

Potential Hazardous Location—An area that is subject to flammable or combustible vapors and particles.

Restraining Device—An apparatus such as a cage, rack, assemblage of bars and other components, or other machinery or equipment that will constrain all rim wheel components during an explosive separation of multi-piece rim wheel or during the sudden release of contained air of a single piece rim wheel.

Rim Manual—A publication containing instructions from the manufacturer or other qualified organization for correct mounting, demounting, maintenance, and safety precautions peculiar to the type of wheel being serviced (refer to **Attachment 2**).

Rim Wheel—An assemblage of tire, tube, and liner (where appropriate), and rim or wheel components.

Shall—Indicates a mandatory requirement.

Should—Indicates a preferred method of accomplishment.

Single Piece Wheel or Single Piece Rim—A vehicle wheel or rim consisting of one part, designed to hold the tire on the rim when the tire is inflated.

Static Electricity—An electrical charge accumulated by an object which may cause a spark when the object comes near or in contact with a second object of opposite or neutral charge.

Test Equipment—Equipment which has a primary function of performing measurement of diagnostic tests.

Will—Is also used to indicate a mandatory requirement and in addition is used to express a declaration of intent, probability, or determination.

Attachment 2**ORDERING INFORMATION FOR OCCUPATIONAL SAFETY AND HEALTH
ADMINISTRATION (OSHA) RIM CHARTS**

OSHA has printed two charts entitled *Demounting and Mounting Procedures for Truck and Bus Tires*, and *Multi-piece Rim Matching Chart*, as part of a continuing campaign to reduce mishaps among employees who service large vehicle rim wheels.

Reprints of the charts are available through the OSHA Area and Regional Offices. The address and telephone number of the nearest OSHA Area Office can be obtained by looking in the local telephone directory under U.S. Government, U.S. Department of Labor, Occupational Safety and Health Administration. Single copies are available without charge.

Organizations desiring single or multiple copies of these charts may order them from the OSHA Publications Office, U.S. Department of Labor, Room N-3101, Washington DC 20210, Telephone (202) 219-4667.

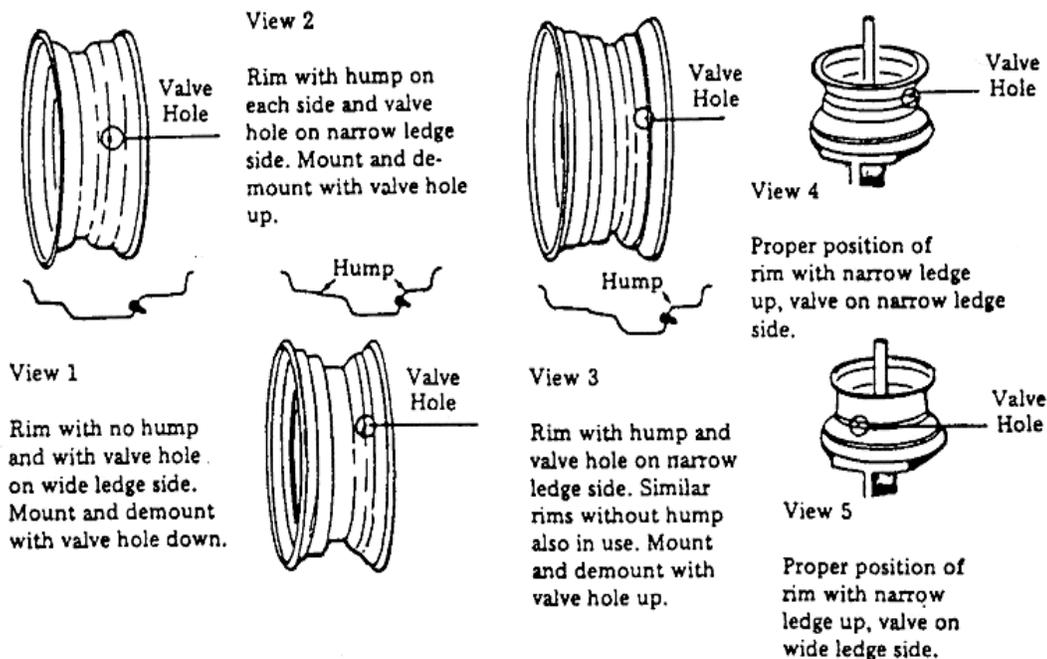
Also refer to: http://www.osha-slc.gov/OshStd_data/1910_0177_APP_B.html.

Supervisors whose facilities service such wheels shall obtain a copy of each OSHA chart and conspicuously post them in the tire and wheel shops.

NOTE: A current rim manual should be available in the service area. This manual may be ordered by writing to the Tire and Rim Association, Inc., 175 Montrose Ave, W. Copley, Ohio 44321, (www.rubber.com/tires/assn/tara.html).

Attachment 3

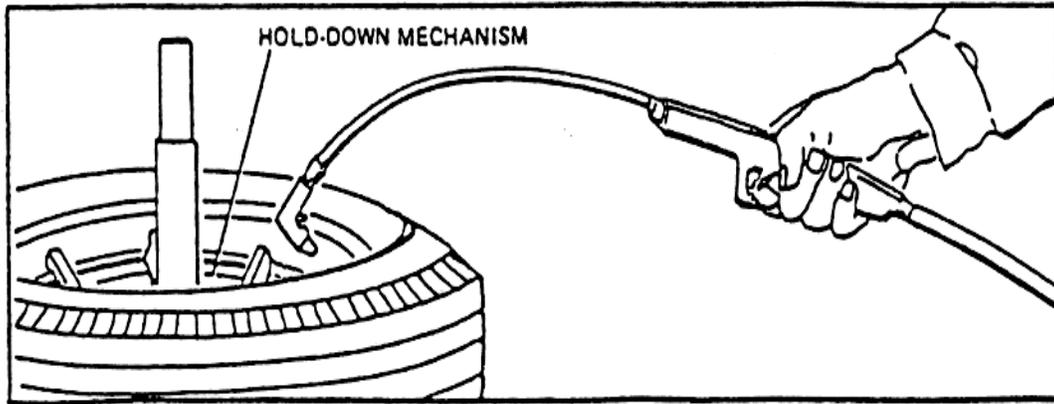
EFFECTS OF RIM DESIGN ON PROPER MOUNTING POSITION
IMPORTANT PROPER PROCEDURES FOR DEMOUNTING
AND MOUNTING TUBELESS PASSENGER CAR TIRES



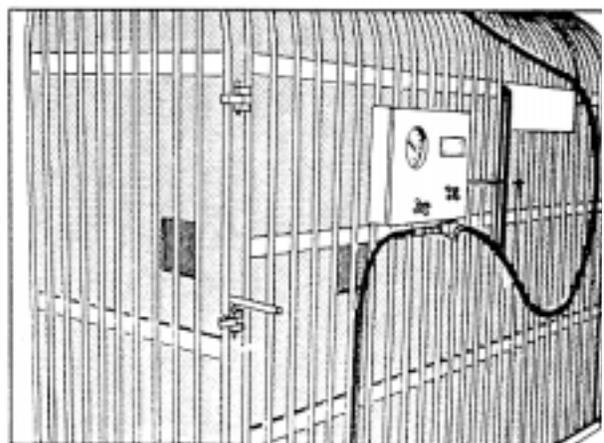
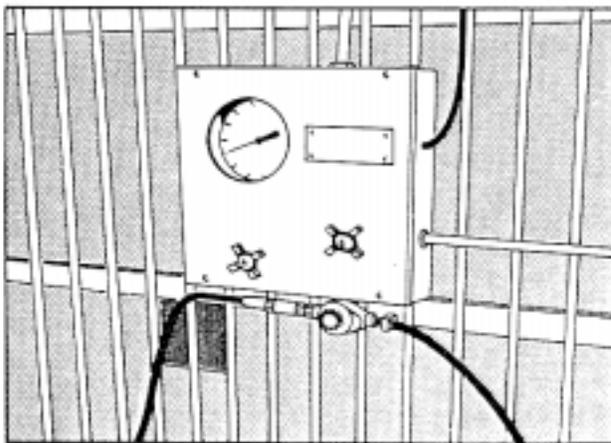
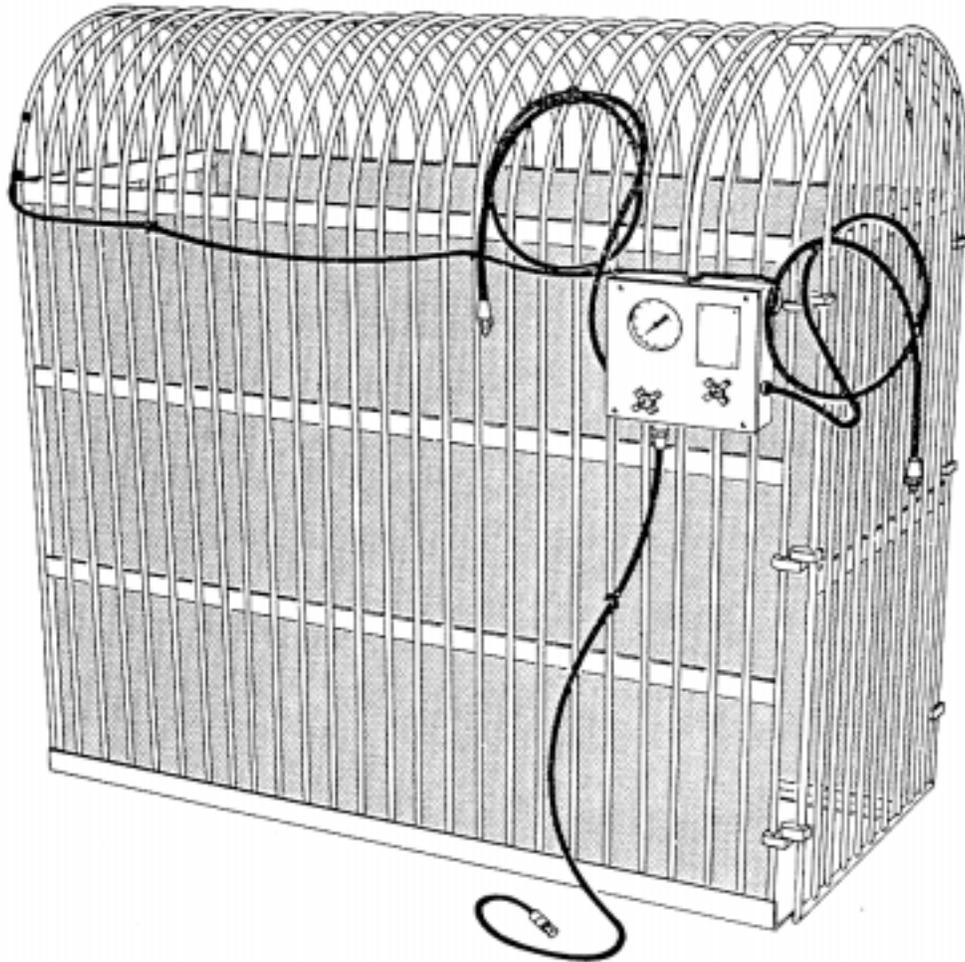
IMPORTANT: In Both Mounting and Demounting, Always Start with the Narrow Bead Ledge.

Attachment 4**USING THE EXTENSION HOSE TO INFLATE A TIRE****TIRE MOUNTING WARNING!**

Failure to comply with these procedures may result in faulty positioning of the tire and (or) rim parts, and cause the assembly to burst with explosive force, sufficient to cause serious physical injury or death. Never mount or use damaged tires or rims.

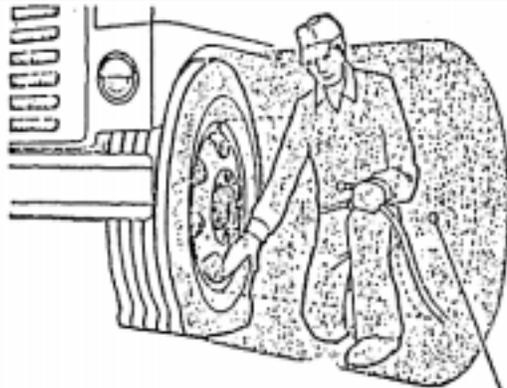


Attachment 5
TIRE INFLATOR CAGE



Attachment 6

TRAJECTORY

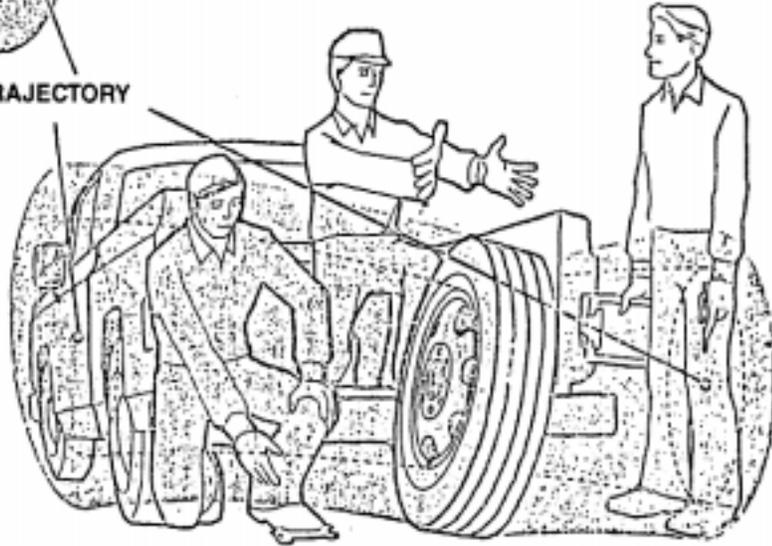


**TRAJECTORY
WARNING
STAY OUT OF
THE TRAJECTORY AS
INDICATED BY SHADED AREA**

Note: Under some circumstances,
the trajectory may deviate
from its expected path



TRAJECTORY



Attachment 7**CHECKLIST—VEHICLE MAINTENANCE SHOPS**

This is not an all-inclusive checklist. It simply highlights some critical items in this standard. Other requirements exist in this standard that are not included in the checklist. Where appropriate, MAJCOMs, DRUs, FOAs, local safety personnel, and supervisors will add to this checklist to include command or individual shop-unique requirements or situations.

GENERAL REQUIREMENTS:

A7.1. Are doors, passageways, or stairs which could be mistaken as an exit or a way to exit clearly marked “NOT AN EXIT” or by a sign indicating actual use, such as “storage room” or “basement”? (Reference paragraph 1.2.1.)

A7.2. Are areas around exit doors and passageways free of obstructions? (Reference paragraph 1.2.1.)

A7.3. Are locks or fastening devices, which would slow or prevent escape from inside the building, prohibited? (Reference paragraph 1.2.1.)

A7.4. Is clear, unrestricted access maintained to on-off power control switches and stations? (Reference paragraph 1.2.2.)

A7.5. Are refueling vehicles and (or) equipment grounded when in the refueler maintenance facility or when undergoing maintenance? (Reference paragraph 1.2.4.)

A7.6. Where compressed air is used for cleaning, is the discharge end of the air line restricted to less than 30 psi? (Reference paragraph 1.2.5.)

A7.7. Are tools not in use kept in suitable metal or fabric containers? (Reference paragraph 1.2.6.)

A7.8. Are vehicle maintenance operations, such as painting, welding, battery work, and wheel and tire maintenance operations performed in separate parts of the facility to prevent operations of one kind from being hazardous to another? (Reference paragraph 1.2.7.)

A7.9. Is the use of any flammable liquid for cleaning shop floors prohibited? (Reference paragraph 1.2.7.)

A7.10. Are signs posted where smoking is prohibited in the shops? (Reference paragraph 1.2.7.)

A7.11. Are workers prohibited from leaving electrical cords and air hoses on the shop floor when not in use? (Reference 1.2.7.)

A7.12. Are shop entrances and exits clearly marked and posted with appropriate traffic control signs to prevent mishaps at these locations? (Reference paragraph 1.2.7.)

A7.13. Are workers prohibited from storing fuel-contaminated clothing in lockers or other confined areas? (Reference paragraph 1.2.8.)

A7.14. Are workers prohibited from using fire protection equipment when removing oil or hydraulic fluid spills? (Reference paragraph 1.2.8.)

A7.15. Are procedures in effect to ensure proper containment measures are available to prevent environmental pollution in the event of a spill? (Reference paragraph 1.2.8.)

A7.16. Is the storage, use, and handling of flammable and combustible liquids accomplished according to AFOSH Standard 91-43 and local fire department requirements? (Reference paragraph 1.2.9.)

A7.17. Is the use of flame-producing equipment prohibited in refueler maintenance shops? (Reference paragraph 1.2.10.)

A7.18. Are efforts made by the supervisor to obtain and use non-flammable solvent when practical? (Reference paragraph 1.2.10.)

A7.19. Does the supervisor ensure personnel are trained annually on the location, selection, and use of fire extinguishers, electrical power disconnecting locations, alarm systems, evacuation procedures, and installed fire protection systems? (Reference paragraph 1.2.10.)

A7.20. Where required, is at least 50 foot-candles of illumination maintained at each work position? (Reference 1.2.11.)

A7.21. Is the consumption of foods or drinks prohibited in shop areas? (Reference paragraph 1.2.12.)

A7.22. Are vented lockers and an emergency eyewash provided for workers who may be contaminated with solvents, fuels, or toxic material? (Reference paragraph 1.2.12.)

A7.23. Are workers trained and do they practice proper manual lifting and carrying techniques in their job to avoid injuries? (Reference paragraph 1.2.13.)

A7.24. Is proper personal protective equipment (PPE) for all jobs or tasks identified, available, and worn by workers? (Reference paragraph 1.2.15.)

BATTERY MAINTENANCE

A7.25. Are workers prohibited from wearing metal rings, watches, bracelets, or other jewelry when they are engaged in battery maintenance? Do they secure metal eyeglasses by a band or cord? (Reference paragraph 2.2.4.)

A7.26. Are all ignition sources prohibited in the vicinity of batteries to prevent ignition of explosive gases produced by batteries? (Reference paragraph 2.2.5.)

A7.27. Are safe battery jump starting procedures used? (Reference paragraph 2.2.7.)

A7.28. Are battery chargers always turned off before a battery is connected or disconnected? (Reference paragraph 2.2.7.)

A7.29. Are carboy tilters or siphons provided and used for handling battery electrolyte? (Reference paragraph 2.2.7.)

A7.30. Is acid always poured INTO water when servicing batteries to prevent reaction and splattering? (Reference paragraph 2.2.7.)

AIR COMPRESSORS:

A7.31. Is the practice of using compressed air to clean clothing or the body prohibited? (Reference paragraph 5.3.3.)

COMPRESSED GAS CYLINDERS:

A7.32. Are all compressed gas cylinders marked, stored, and handled according to instructions in **Chapter 6** of this standard? (Reference paragraphs 6.1. and 6.2.)

LIFTING DEVICES:

A7.33. Do operators using hydraulic vehicle lifts ensure vehicle doors, hood, and trunk are closed, no one is inside the vehicle, and all people and obstructions are clear of the vehicle prior to lifting it? (Reference paragraph 7.3.1.)

A7.34. Are workers prohibited from working under vehicles supported on hydraulic floor jacks, post jacks, or mechanical jacks? Do workers block wheels and place axle or frame stands on both sides to support the vehicle before repair operations are begun? (Reference paragraph 7.3.3.)

TIRE AND WHEEL MAINTENANCE:

A7.35. Are all tire and wheel maintenance workers qualified? (Reference paragraph 8.1.)

A7.36. Does the tire and wheel maintenance supervisor ensure the use of restraining devices for servicing multi-piece rim wheels? (Reference paragraph 8.2.)

A7.37. Are current OSHA tire charts, rim manuals, and applicable TOs available to ensure extensive damage to equipment and serious or fatal injuries to personnel are prevented? (Reference paragraphs 8.2.6., 8.2.7., and 8.2.8.)

A7.38. Are tires on multi-piece rim wheels completely deflated by removing the valve core before the rim wheel is removed from the axle? (Reference paragraph 8.4.1.)

A7.39. When reinflation of tires installed on multi-piece rims is approved for tires already mounted on the vehicle, are safeguards used to encase the wheel (chains, remote control inflation equipment, etc.)? (Reference paragraph 8.4.3.)

A7.40. Are air hoses for inflating tires long enough to allow the employee to stay outside the trajectory (see **Attachment 4** and **Attachment 6**)? (Reference paragraph **8.5.8**.)

A7.41. Is the loosening of lug nuts on duals prohibited until all air is exhausted from both tires? (Reference paragraph **8.6.5**.)

MAINTENANCE OPERATIONS:

A7.42. Do vehicle operators and mechanics sound vehicle horns before backing, intermittently during backing (unless vehicle is equipped with backup alarms), and prior to entering or leaving the maintenance shop? (Reference paragraph **9.1.2**.)

A7.43. Do vehicle operators, and mechanics ensure rolldown or side sliding doors are completely opened before a vehicle enters or exits the maintenance shop? (Reference paragraph **9.1.2**.)

A7.44. Do workers remove all items of jewelry before working on or around shop equipment or vehicles? (Reference paragraph **9.1.4**.)

A7.45. Are all new or used gas tanks, oil barrels, or drums purged and inerted before any welding or cutting is attempted? (Reference paragraph **9.2.2**.)

A7.46. Are hot pressurized radiators allowed to cool before they are opened? (Reference paragraph **9.2.5**.)

A7.47. Are vehicles with leaking fuel tanks immediately removed from the maintenance shop? (Reference paragraph **9.2.6**.)

A7.48. Are open flame and spark-producing devices kept at least 25 feet from the refueling maintenance shop? (Reference paragraph **9.2.7**.)

A7.49. Are refueling vehicle tank pumping systems, filter separator, and the tank cleaned out and purged prior to performing major maintenance on the main tank? (Reference paragraph **9.2.7**.)

A7.50. Is maintenance of fuel servicing vehicles prohibited in maintenance shops with other vehicular equipment? (Reference paragraph **9.2.8**.)

A7.51. Are vehicle maintenance repair pits guarded? (Reference paragraph **9.2.9**.)